TRANSACTIONS

AND

PROCEEDINGS

OF THE

NEW ZEALAND INSTITUTE,

1870.

VOL. III

EDITED AND PUBLISHED UNDER THE AUTHORITY OF THE BOARD OF GOVERNORS OF THE INSTITUTE,

BY

JAMES HECTOR, M.D., F.R.S.

ISSUED MAY, 1871.

WELLINGTON:
JAMES HUGHES, PRINTER, LAMBTON QUAY.
TRUBNER & CO., 60, PATERNOSTER ROW, LONDON.

PREFACE.

The arrangement of the third volume of the *Transactions* has been altered from that adopted in either of the preceding volumes, in order to meet a generally expressed wish that the *Proceedings* should be issued in anticipation of the main body of the work, the publication of which is necessarily delayed on account of the illustrations. The Proceedings of the Societies were therefore printed in a separate form, and published in July and January last.

The quantity of matter contributed for publication being greatly in excess of that in any former year, the Governors have been reluctantly compelled to order the abridgment, in some cases, of papers of interest, and to postpone the publication of the following:—"On the Mechanics and Mechanical Economy of Railways," by G. M. Barr; "On Economical Railways and Rolling Stock," and "On the Power required for Working Flax Machines," by James Stewart, C.E.; "On Co-operation, as regards the Union of Capital and Labour," by Stuart Hawthorne; "Notes on Mr. Hawthorne's Paper on Co-operation," by Robert Stout; "On the Sailing Flight of the Albatros; a Reply to J. S. Webb," by Capt. Hutton, F.G.S.; "On the Adaptation of India-rubber Tires to Wooden Tramways," by J. C. Crawford, F.G.S.; "On the Analysis of the Registry of Mortality in the Christchurch District the last ten years," by Ll. Powell, M.R.C.S. St.A.; "On the Best Means of Diffusing and Promoting Higher Education in this Colony," by Frank C. Simmons, M.A., Head Master of Nelson College; "On the Botany of Tahiti;" "Ethnographical Considerations on the Whence of the Maori," by J. T. Thomson, F.R.G.S.

The three Papers first mentioned, being of a practical and technical character, will probably be published with other Official Reports on the same subjects, while the others, with one exception, were selected for postponement on account of their being either of a controversial character, or because they have been already published at length in public prints. With regard, however, to Mr. Thomson's elaborate Ethnographical Paper on the "Origin of the Maori Race," it is necessary to state that the manuscript copy was not received until April, when the volume was almost ready for publication, and as this Essay requires many illustrations it could not be inserted without delaying the issue of the volume beyond the period at which Members expect its distribution.

It will be observed that the greatly increased space occupied by original articles, viz., 351 pages as against 248 pages in Vol. II., has also excluded from publication Lectures and Addresses of a general character, such as were inserted in a separate section of the preceding volume.

The Appendix contains the usual Summary of the Meteorological Returns for the year, for assistance in the compilation of which the Editor is indebted to Mr. R. B. Gore.

The List of Members of the Institute shows that in addition to the nine Honorary Members, the Affiliated Societies have now 544 Ordinary Members; the number on last year's roll being 342. This increase is due in part to the affiliation during the past year of the Nelson Association, and also to the large accession of new Members, especially in the Societies established in Auckland and Dunedin.

Notwithstanding that in several cases illustrations sent with papers have been omitted when not absolutely necessary to explain the text, the number of Plates has increased in this volume to 30; there being in last year's volume only 23. The Governors have again to tender their thanks to Mr. J. Buchanan for the great zeal with which he has devoted himself to the preparation of these illustrations, and to the Hon. the Colonial Secretary for placing at their disposal the superior skill and appliances of the Government Lithographic Printing Department.

For assistance in revising a portion of the work for the press during his temporary absence, the Editor has to thank the Hon. W. B. D. Mantell.

Wellington, 20th April, 1871.

CONTENTS.

PROCEEDINGS.

(INCLUDING MINUTES OF MEETINGS, ANNIVERSARY ADDRESSES, ABSTRACTS OF PAPERS, VERBAL DESCRIPTIONS, ETC.)

NEW ZEALAND INSTITUTE.

	PAGES
Anniversary Address of the President, Sir GEORGE F. BOWEN, G.C.M.G. ...	1—7
First Annual Report by the Governors	9—10
Accounts of the New Zealand Institute, 1868–69	11
Second Annual Report by the Governors	11—14
Accounts of the New Zealand Institute, 1869–70	14

WELLINGTON PHILOSOPHICAL SOCIETY.

Abstract Report of Council	15
Election of Office-bearers for 1870	15
Description of a Specimen of *Berardius Arnuxii.* By F. J. Knox, L.R.C.S.E.	15—16
Geological Structure of the Kaimanawa Range. By J. Hector, M.D., F.R.S.	16—17
Anniversary Address of the President, the Hon. W. B. D. Mantell, F.G.S. ..	17—24
Notice of a Meteor observed from Wellington. By E. Stowe	24
Meetings for Discussion on Flax	27—35
Notes on Specimens of Adipocere. By J. Hector, M.D., F.R.S. ..	73
Notice of a Meteor observed from Wellington by Mr. Hardy	76
Results of Observations taken for Longitude by Meridian Transits of the Moon, taken at the Hutt Observatory. By Henry Jackson, Chief Surveyor Province of Wellington. (Abstract.)	82—83

AUCKLAND INSTITUTE.

Abstract of Annual Report	39
Anniversary Address of the President, Rev. A. G. Purchas, M.R.C.S.E. ...	39—46
On certain changes in the Habits of Rats, at Raglan. Letter from Captain Johnstone to Captain F. W. Hutton, F.G.S.	47
On a supposed Native Rat, observed at Whangarei. Extract from a letter from Mr. J. Martin to Captain Hutton	88
On certain projected Street Improvements in Auckland. By R. W. Dyson ..	90—91

PHILOSOPHICAL INSTITUTE OF CANTERBURY.

Interim Report of the Grass Committee, with Schedule of Queries and List of Native Grasses with regard to which information is specially desired ...	51—52
Resolutions passed respecting desirability of Establishing Schools of Mines in New Zealand	92—93
Draft Petition to House of Representatives on Establishment of Schools of Mines	94

PAGES

Annual Report ... ... 96—97

Report of the Committee appointed to confer with the Provincial Government on the Institution of Lectureships in connection with the Museum ... 97

Report of the Committee appointed to obtain information as to Native and other Grasses ... ... 97—98

OTAGO INSTITUTE.

Note on Coastal Whaling Stations, and the probability of their being instrumental in the destruction of the young of the Whale. By J. S. Webb ... 55—56

On Modern Methods of Geometry. By D. Brent. (Abstract.) ... 59—60

On the Moon and the Weather. By J. S. Webb. (Abstract.) ... ... 62—64

On the Discovery of New Zealand. By A. Eccles, F.R.C.S. (Abstract.) ... 65

Abstract of Report ... ... 67—68

Election of Office-bearers 68

Report on the Whale Fisheries. By the Honorary Secretary ... ... 68—70

On a (supposed) New Species of Bittern, from the Lake District. By A. C. Purdie. (Abstract.) ... ... 99—100

On the Skeleton of a Bird (supposed to be a Swan) found in Dunedin. By A. C. Purdie. (Abstract.) 100

On Central Forces,—especially as regards Force varying directly as the distance. By R. Wilding. (Abstract.) 101

NELSON ASSOCIATION FOR THE PROMOTION OF SCIENCE AND INDUSTRY.

On Technical Education. By Mr. Mackay. (Abstract.) 107—108

Election of Office-bearers 109

TRANSACTIONS.

ZOOLOGY.

ART. I. On the New Zealand Rat. By Walter Buller, F.L.S., F.G.S., F.R.G.S., C.M.Z.S. ... ... 1—4

II. A List of the Lizards inhabiting New Zealand, with Descriptions. By Walter Buller ... ... 4—11

III. Critical Notes on the Ornithological portion of "Taylor's New Zealand and its Inhabitants." By Walter Buller ... ... 11—14

IV. Notice of a Species of *Megapode*, in the Auckland Museum. By Walter Buller ... ... 14—15

V. On *Zosterops lateralis* in New Zealand, with an Account of its Migrations. By Walter Buller ... ... 15—23

VI. On the Structure and Habits of the Huia (*Heteralocha Gouldi*). By Walter Buller ... ... 24—29

VII. On the Katipo, or Venomous Spider of New Zealand. By Walter Buller ... ... 29—34

VIII. Notes on the Genus *Deinacrida* in New Zealand. By Walter Buller 34—37

IX. Further Notes on the Ornithology of New Zealand. By Walter Buller ... ... 37—56

Note to Art. II.—Buller's List of New Zealand Lizards ... 56

X. On *Latrodectus* (Katipo), the Poisonous Spider of New Zealand. By Ll. Powell, M.R.C.S.St.A. ... . 56—59

XI. On the Birds of New Zealand (Part II.) By T. H. Potts .. 59—109

XII. Notes on an Egg of *Alca impennis*, Linn., in the Collection of the writer. By T. H. Potts ... ... 109—110

XIII. On the Nests and Eggs of some Species of New Zealand Birds not previously described. By Captain F. W. Hutton, F.G.S. ... 111—112

PAGES

ART. XIV. Notes on the Habits of *Podiceps cristatus*. By W. T. L. Travers, F.L.S. ... ... 113—116

XV. Notes upon a New Zealand Flesh-fly. By W. T. L. Travers ... 116—120

XVI. On the Absence of the Eel from the Upper Waters of the Waiau-ua and its Tributaries. By W. T. L. Travers ... .. 120—122

XVII. Notes on the Skull of *Balæna marginata*, described in "Transactions of the New Zealand Institute," Vol. ii., p. 26, as the Type of a New Genus, *Neobalæna*. By Dr. J. E. Gray, F.R.S., etc. ... ... 123—124

XVIII. Observations on the *Ziphidæ*, a Family of the Cetacea. By F. J. Knox, L.R.C.S.E. With Notes by Dr. Hector ... ... 125—129

XIX. Short Notice of a Remarkable Tooth of a Cetacean. By F. J. Knox 130

XX. Observations on *Coridodax pullus*. By F. J. Knox ... ... 130—132

XXI. On the *Salmonidæ* of New Zealand. By James Hector, M.D., F.R.S. ... ... 133—136

XXII. On a New Species of Fish, *Coryphænoides Novæ Zelandiæ ;* Native name, Okarari. By James Hector 136

XXIII. On the *Lepidoptera* of Otago. By A. Bathgate ... ... 137—141

BOTANY.

XXIV. Notes on the Botany of Certain Places in the Waikato District, April and May, 1870. By T. Kirk ... ... 142—147

XXV. On the Occurrence of Littoral Plants in the Waikato District. By T. Kirk ... ... 147—148

XXVI. On the Flora of the Isthmus of Auckland and the Takapuna District. By T. Kirk ... ... 148—161

XXVII. An Account of an Undescribed *Pittosporum* and *Loranthus*, in the Herbarium of the Colonial Museum, Wellington. By T. Kirk ... 161—163

XXVIII. Notes on Certain New Zealand Plants not included in the "Handbook of the New Zealand Flora." By T. Kirk ... ... 163—166

XXIX. On the Botany of the Northern Part of the Province of Auckland. By T. Kirk. ... ... 166—177

XXX. Descriptions of New Plants. By T. Kirk ... ... 177—180

XXXI. On the Cultivation of some Species of Native Trees and Shrubs. By T. H. Potts and W. Gray ... ... 181—202

XXXII. On the Natural History Collections in the Otago Museum. By J. S. Webb ... ... 203—208

XXXIII. On some New Species and Varieties of New Zealand Plants. By John Buchanan, of the Geological Survey Department ... 208—212

XXXIV. On Recent Changes in the Nomenclature of the New Zealand Ferns. By John D. Enys 213

XXXV. On some *Algæ* from the Chatham Islands. By Professor J. Agardh, of Lund. Communicated by F. von Mueller, C.M.G., M.D., Ph.D., F.R.S. ... ... 213—215

CHEMISTRY.

XXXVI. On the Absorption of Silver by Gold, and its Effects in Retarding Amalgamation. By W. Skey, Analyst to the Geological Survey of New Zealand ... ... 216—220

XXXVII. On the Production of a Mono-hydrate of Chloride of Barium. By W. Skey. With Notes on its Crystallization, by E. H. Davis, F.C.S., F.G.S. ... ... 220—221

XXXVIII. Researches on the Absorptive Properties of Platinum. By W. Skey... ... ... 221—222

XXXIX. On the Capability of Certain Sulphides to form the Negative Pole of a Galvanic Circuit or Battery. By W. Skey ... ... 222—225

PAGES

ART. XL. On the Reduction of Certain Metals from their Solutions by Metallic Sulphides, and the relation of this to the occurrence of such Metals in a Native State. By W. Skey .. .. 225—231

XLI. On the Electro-motive Power of Metallic Sulphides. By W. Skey 232—236

XLII. On Certain Properties of the Tutu Plant (*Coriaria ruscifolia*). By H. G. Hughes, M.P.S. ... ... 237—243

GEOLOGY.

XLIII. On the Relative Ages of the Waitemata Series and the Brown Coal Series of Drury and Waikato. By Captain F. W. Hutton, F.G.S. 244—249

XLIV. On a Carbonaceous Mineral from Whangarei Harbour. By Captain F. W. Hutton ... ... 250—251

XLV. On the Artesian Wells near Napier. By Captain F. W. Hutton ... 251

XLVI. On the Occurrence of Native Mercury near Pakaraka, Bay of Islands. By Captain F. W. Hutton . . . 252—253

XLVII. On the Physical Geography of the Lake Districts of Otago. By James M'Kerrow ... ... 254—263

XLVIII. On the Sand Hills, or Dunes, in the neighbourhood of Dunedin. By P. Thomson ... ... 263—269

XLIX. On the Disposition of Alluvial Deposits on the Otago Gold Fields. By L. O. Beal ... ... 270—278

L. Notes on the Geology of White Island. By James Hector, M.D., F.R.S., Director Geological Survey of New Zealand. With Observations on the Crystalline forms of the Specimens of Sulphur obtained. By E. H. Davis, F.G.S., F.C.S., of the Geological Survey Department ... ... 278—285

LI. On the Nomenclature of Rocks. By E. H. Davis .. ... 285—287

LII. On a New Form of Iron Pyrites. By E. H. Davis 287

LIII. Remarks on the Resemblance of the Country in the neighbourhood of the Dun Mountain, and Wairoa Gorge, to the Mining Districts of Queensland and Auckland. By W. Wells ... ... 287—292

LIV. Notes on the Thermal Springs, in the Hanmer Plains, Province of Nelson. By Julius Haast, Ph.D., F.R.S. With letter from Dr. Hector to the Superintendent of Nelson on the same subject 293—298

MISCELLANEOUS.

LV. On Changes in the Hokitika River. By James Rochfort, C.E. ... 299—303

LVI. On the Gyration of the Wind in New Zealand, with its Characteristics in the various Quarters. By W. S. Hamilton. (Author's Abstract.) ... . 303—306

LVII. On Periodic Vertical Oscillations in the Earth's Atmosphere, and the Connection existing between the Fluctuations of Pressure, as indicated by the Barometer, and Changes in the Weather. By H. Skey, Government Meteorological Observer at Dunedin ... 306—311

LVIII. Notes on the Chatham Islands and their Inhabitants. By Gilbert Mair ... ... 311—313

LIX. On the Analogy between the Maori and Indo-European Languages. By Edwin Fairburn. (Abstract.) ... ... 313—315

LX. On an Adaptation of Water Power. By J. C. Crawford, F.G.S. 315—316

LXI. On the Use of the Semicircular Protractor, with a Description of an Improved Form of that Instrument. By James Stewart, C.E., Assoc. Inst. C.E. ... ... 316—318

LXII. On the Use of Salt Water in the "Field" Boiler. By James Stewart 318—320

LXIII. On a Self-acting Clamp Mountain Wire Tramway. By F. W. Wright, L.M.B. Toronto. (Abstract.) ... ... 321—322

LXIV. On the Currents, Temperature, and Saltness of the Ocean. By W. B. Bray. (Abstract.) ... ... 322—324

		PAGES
ART. LXV.	Notes on the Conduction of Electricity. By J. Duigan. (Abstract.)	324—325
LXVI.	Notes on a Paper "On Sinking Funds," read by Captain Hutton before the Auckland Institute, September 7, 1868. (*Trans. N. Z. Inst.*, Vol. ii., p. 236.) By J. S. Webb. (Abstract.) ...	325
	Errata in Captain Hutton's paper, Vol. ii. of the *Transactions* ...	325
LXVII.	On the Changes effected in the Natural Features of a New Country by the Introduction of Civilized Races. (Part III.) By W. T. L. Travers, F.L.S. (Author's Abstract.)	326—336
LXVIII.	On the Political Economy of Railways. By H. S. Chapman, One of the Judges of the Supreme Court of New Zealand ...	337—351

APPENDIX.

Meteorological Statistics of New Zealand for 1870	353—355
List of Earthquakes in New Zealand in 1870	355
Notes on the Weather during 1870	355—357
Lists of Members	358—363
Board of Governors of the New Zealand Institute...	x
Abstract of Rules and Statutes of the New Zealand Institute	x—xii
List of Incorporated Societies	xiii
List of Office-bearers and Extracts from the Laws of Incorporated Societies ...	xiii—xvi

ILLUSTRATIONS.

PLATE		PAGE
1.	Buller.—New Zealand Rat	2
2.	,, New Zealand Lizards (*Naultinus*, *Mocoa*, *Hinulia*) .. .	4
3.	,, Blight Bird (*Zosterops*)	16
4.	,, Huia (*Heteralocha*)	24
5.	Powell.—Katipo, or Poisonous Spider of New Zealand . .	56
5b.	Buller.—Weta (*Deinacrida*)	34
6.	Potts.—Crook-bill (*Anarhynchus*)	94
7.	,, Nests of Kaka (*Nestor*) and Weka (*Ocydromus*)	86
8.	,, ,, New Zealand Fantail (*Rhipidura*) and New Zealand Dabchick (*Podiceps*)	78
9.	,, ,, New Zealand Falcon (*Hieracidea*)	60
10.	,, ,, Pukeko (*Porphyrio*)	102
11.	,, ,, New Zealand Robin (*Petroica*) and New Zealand Canary (*Mohoua*)	76
12.	,, ,, Blight Bird (*Zosterops*) and Stitch Bird (*Pogonornis*) ...	74
12b.	Buller.—Kiwi (*Apteryx*)	52
13.	Knox and Hector.—Ziphid Whale	124
14 to 17.	,, ,, ,, ,, ...	128
18.	Hector.—New Zealand Fishes (*Coryphænoides*, *Coridodax*, and *Retropinna*) ...	132
19.	,, New Zealand *Salmonidæ*	136
20 to 24.	Rochfort.—Plans of Hokitika River	302
25.	Davis.—Sulphur Crystals	284
26.	,, New form of Iron Pyrites and Chloride of Barium Crystals ...	220
27.	Hutton.—Geological Sections in Auckland and Hawke's Bay, and Plan of Hot Springs near Bay of Islands	248
28.	Hector.—Sections of White Island	280

NEW ZEALAND INSTITUTE,

ESTABLISHED UNDER AN ACT OF THE GENERAL ASSEMBLY OF NEW ZEALAND, INTITULED "THE NEW ZEALAND INSTITUTE ACT, 1867."

BOARD OF GOVERNORS.

(EX OFFICIO.)

HIS EXCELLENCY THE GOVERNOR.
THE HON. THE COLONIAL SECRETARY.
HIS HONOR THE SUPERINTENDENT OF WELLINGTON.

1870.

(NOMINATED.)

SIR DAVID MONRO
JAMES EDW. FITZGERALD, ESQ.
W. T. L. TRAVERS, ESQ., F.L.S.
J. HECTOR, ESQ., M.D., F.R.S.
ALFRED LUDLAM, ESQ.
C. KNIGHT, ESQ., F.R.C.S.

(ELECTED.)

HIS HONOR MR. JUSTICE WARD
T. B. GILLIES, ESQ.
JULIUS HAAST., ESQ, Ph.D., F.R.S.

1871.

(NOMINATED.)

SIR DAVID MONRO
J. E. FITZGERALD, ESQ., C.M.G.
W. T. L. TRAVERS, ESQ., F.L.S.
JAMES HECTOR, ESQ., M.D., F.R.S.
ALFRED LUDLAM, ESQ.
C. KNIGHT, ESQ., F.R.C.S.

(ELECTED.)

T. B. GILLIES, ESQ
W. ROLLESTON, ESQ., B.A.
HIS HONOR MR. JUSTICE CHAPMAN.

ABSTRACTS OF RULES AND STATUTES,

GAZETTED IN THE "NEW ZEALAND GAZETTE," MARCH 9, 1868.

SECTION I.

Incorporation of Societies.

1. No Society shall be incorporated with the Institute under the provisions of "The New Zealand Institute Act, 1867," unless such Society shall consist of not less than twenty-five members, subscribing in the aggregate a sum of not less than fifty pounds sterling annually, for the promotion of art, science, or such other branch of knowledge for which it is associated, to be from time to time certified to the satisfaction of the Board of Governors of the Institute by the Chairman for the time being of the Society.

2. Any Society incorporated as aforesaid shall cease to be incorporated with the Institute in case the number of the Members of the said Society shall at any time become less than twenty-five, or the amount of money annually subscribed by such Members shall at any time be less than £50.

3. The bye-laws of every Society to be incorporated as aforesaid shall provide for the expenditure of not less than one-third of its annual revenue in

or towards the formation or support of some local public Museum or Library; or otherwise shall provide for the contribution of not less than one-sixth of its said revenue towards the extension and maintenance of the Museum and Library of the New Zealand Institute.

4. Any Society incorporated as aforesaid which shall in any one year fail to expend the proportion of revenue affixed in manner provided by Rule 3 aforesaid, shall from thenceforth cease to be incorporated with the Institute.

5. All papers read before any Society for the time being incorporated with the Institute, shall be deemed to be communications to the Institute, and may then be published as proceedings or transactions of the Institute, subject to the following regulations of the Board of the Institute regarding publications:

Regulations regarding Publications.

(*a*) The publications of the Institute shall consist of a current abstract of the proceedings of the Societies for the time being incorporated with the Institute, to be intituled, "Proceedings of the New Zealand Institute," and of transactions comprising papers read before the Incorporated Societies (subject, however, to selection as hereinafter mentioned), to be intituled, "Transactions of the New Zealand Institute."

(*b*) The Institute shall have power to reject any papers read before any of the Incorporated Societies.

(*c*) Papers so rejected will be returned to the Society before which they were read.

(*d*) A proportional contribution may be required from each Society towards the cost of publishing the proceedings and transactions of the Institute.

(*e*) Each Incorporated Society will be entitled to receive a proportional number of copies of the proceedings and transactions of the Institute to be, from time to time, fixed by the Board of Governors.

(*f*) Extra copies will be issued to any of the Members of Incorporated Societies at the cost price of publication.

6. All property accumulated by or with funds derived from Incorporated Societies and placed in the charge of the Institute shall be vested in the Institute, and be used and applied at the discretion of the Board of Governors for public advantage, in like manner with any other of the property of the Institute.

7. Subject to "The New Zealand Institute Act, 1867," and to the foregoing rules, all Societies incorporated with the Institute shall be entitled to retain or alter their own form of constitution and the bye-laws for their own management, and shall conduct their own affairs.

8. Upon application signed by the Chairman and countersigned by the Secretary of any Society, accompanied by the certificate required under Rule No. 1, a certificate of incorporation will be granted under the Seal of the Institute, and will remain in force as long as the foregoing rules of the Institute are complied with by the Society.

Section II.

For the Management of the Property of the Institute.

9. All donations by Societies, Public Departments, or private individuals, to the Museum of the Institute, shall be acknowledged by a printed form of receipt, and shall be duly entered in the books of the Institute provided for that purpose, and shall then be dealt with as the Board of Governors may direct.

10. Deposits of articles for the Museum may be accepted by the Institute, subject to a fortnight's notice of removal, to be given either by the owner of the articles or by the Manager of the Institute, and such deposits shall be duly entered in a separate catalogue.

11. Books relating to Natural Science may be deposited in the Library of the Institute, subject to the following conditions:—

(a) Such books are not to be withdrawn by the owner under six months' notice, if such notice shall be required by the Board of Governors.

(b) Any funds specially expended on binding and preserving such deposited books, at the request of the depositor, shall be charged against the books, and must be refunded to the Institute before their withdrawal, always subject to special arrangements made with the Board of Governors at the time of deposit.

(c) No books deposited in the Library of the Institute shall be removed for temporary use except on the written authority or receipt of the owner, and then only for a period not exceeding seven days at any one time.

12. All books in the Library of the Institute shall be duly entered in a catalogue, which shall be accessible to the public.

13. The public shall be admitted to the use of the Museum and Library, subject to bye-laws to be framed by the Board.

Section III.

14. The Laboratory shall, for the time being, be and remain under the exclusive management of the Manager of the Institute.

Section IV.

Of date 23rd September, 1870.

Honorary Members.

Whereas the rules of the Societies incorporated under the New Zealand Act provide for the election of Honorary Members of such Societies; but inasmuch as such Honorary Members would not thereby become Members of the New Zealand Institute, and whereas it is expedient to make provision for the election of Honorary Members of the New Zealand Institute, it is hereby declared—

1st. Each Incorporated Society may, in the month of November next, nominate for election as Honorary Members of the New Zealand Institute, three persons, and in the month of November in each succeeding year, one person, not residing in the Colony.

2nd. The names, descriptions, and addresses of persons so nominated, together with the grounds on which their election as Honorary Members is recommended, shall be forthwith forwarded to the Manager of the New Zealand Institute, and shall by him be submitted to the Governors at the next succeeding meeting.

3rd. From the persons so nominated, the Governors may select, in the first year, not more than nine; and in each succeeding year not more than three, who shall from thenceforth be Honorary Members of the New Zealand Institute, provided that the total number of Honorary Members shall not exceed thirty.

LIST OF INCORPORATED SOCIETIES.

NAME OF SOCIETY.	DATE OF INCORPORATION
Wellington Philosophical Society	June 10, 1868.
Auckland Institute	June 10, 1868.
Philosophical Institute of Canterbury	October 22, 1868.
Otago Institute	October 18, 1869.
Nelson Association for the Promotion of Science and Industry	September 23, 1870.

OFFICE-BEARERS OF THE WELLINGTON PHILOSOPHICAL SOCIETY.

1870.

President.

W. B. D. MANTELL, Esq., F.G.S.

Vice Presidents.

J. C. CRAWFORD, Esq., F.G.S. | R. PHARAZYN, Esq., F.R.G.S.

Council.

W. T. L. TRAVERS, Esq., F.L.S. — J. KEBBELL, Esq.
J. HECTOR, Esq., M.D., F.R.S. — W. LYON, Esq., F.G.S.
W. BULLER, Esq., F.L.S., F.G.S.

Honorary Secretary, *pro tem.*

R. PHARAZYN, Esq.

1871.

President.

W. T. L. TRAVERS, Esq., F.L.S.

Vice Presidents.

J. C. CRAWFORD, Esq., F.G.S. | W. BULLER, Esq., F.L.S., F.G.S.

Council.

ROBERT HART, Esq. — J. KEBBELL, Esq.
JAMES HECTOR, Esq., M.D., F.R.S. — W. LYON, Esq., F.G.S.
W. SKEY, Esq.

Hon. Secretary and Treasurer.

F. M. OLLIVIER, Esq.

Extracts from the Laws of the Wellington Philosophical Society.

5. Every Member shall contribute annually to the funds of the Society the sum of one guinea.

6. The annual contribution shall be paid in advance, on or before the first day of January in each year.

7. The sum of ten pounds may be paid at any time as a composition of the ordinary annual payment for life.

17. General Meetings for business of Members of the Society shall be held in the evening of one day or more in each quarter (the time and place of meeting to be fixed by the Council, and duly announced by the Secretary), to receive the Secretary's Report, and to carry out the general objects and business of the Society.

OFFICE-BEARERS OF THE AUCKLAND INSTITUTE.

1870.

PRESIDENT.

A. G. PURCHAS, Esq., M.R.C.S.E.

COUNCIL.

His Honor T. B. GILLIES.
Captain F. W. HUTTON, F.G.S.
T. PEACOCK, Esq.
J. STEWART, Esq., C.E.
T. HEALE, Esq., C.E.
S. J. STRATFORD, Esq., M.R.C.S.E.

SECRETARY AND TREASURER.

T. KIRK, Esq.

1871.

PRESIDENT.

T. HEALE, Esq., C.E.

COUNCIL.

His Honor T. B. GILLIES.
Rev. J. KINDER.
T. KIRK, Esq.
H. H. LUSK, Esq.
Rev. A. G. PURCHAS, M.R.C.S.E.
J. STEWART, Esq., C.E.
S. J. STRATFORD, Esq., M.R.C.S.E.
T. F. S. TINNE, Esq.

SECRETARY AND TREASURER.

T. KIRK, Esq.

AUDITOR.

G. B. OWEN, Esq.

Extracts from the Laws of the Auckland Institute.

4. New members on election to pay one guinea entrance fee, in addition to the annual subscription of one guinea; the annual subscriptions being payable in advance on the first day of April for the then current year.

5. Members may at any time become Life Members by one payment of ten pounds ten shillings, in lieu of future annual subscriptions.

10. Annual General Meeting of the Society on the third Monday of February in each year. Ordinary Business Meetings are called by the Council from time to time.

OFFICE-BEARERS OF THE PHILOSOPHICAL INSTITUTE OF CANTERBURY.

PATRON.

His Honor W. ROLLESTON, Superintendent.

1870.

PRESIDENT.

JULIUS HAAST, Esq., Ph.D., F.R.S.

VICE PRESIDENTS.

Rev. Canon WILSON, M.A.
C. DAVIE, Esq.

COUNCIL.

R. M. FEREDAY, Esq.
E. JOLLIE, Esq.
H. J. TANCRED, Esq.
W. ROLLESTON, Esq., B.A.
SELBY TANCRED, Esq., C.E.
Ll. POWELL, Esq., M.D.

1871.

PRESIDENT.

JULIUS HAAST, Esq., Ph.D., F.R.S.

VICE PRESIDENTS.

HON. JOHN HALL.	REV. C. FRASER, M.A., F.G.S.

COUNCIL.

J. T. ARMSTRONG, Esq.	R. W. FEREDAY, Esq.
W. B. BRAY, Esq., C.E.	HIS HONOR W. ROLLESTON, B.A.
J. W. S. COWARD, Esq.	J. S. TURNBULL, Esq., M.D.,

HONORARY TREASURER.

JOHN INGLIS, Esq.

HONORARY SECRETARY.

LLEWELLYN POWELL, Esq., M.D.

Extracts from the Laws of the Philosophical Institute of Canterbury.

VII. The Ordinary Meetings of the Institute shall be held every first week during the months from March to November inclusive.

XXV. Members of the Institute shall pay two guineas annually as a subscription to the funds of the Institute.

XXVII. Members may compound for all annual subscriptions of the current and future years by paying thirty guineas.

OFFICE-BEARERS OF THE OTAGO INSTITUTE.

1869-70.

PRESIDENT.

HIS HONOR MR. JUSTICE WARD.

VICE PRESIDENTS.

ALFRED ECCLES, Esq., F.R.C.S.E.	ARTHUR BEVERLEY, Esq.

COUNCIL.

L. O. BEAL, Esq.	STUART HAWTHORNE, Esq.
CAPTAIN FRASER.	REV. D. M. STUART.
ROBERT GILLIES, Esq.	JAMES SMITH, Esq.

J. T. THOMSON, Esq.

HONORARY TREASURER.

W. D. MURISON, Esq.

HONORARY SECRETARIES.

J. S. WEBB, Esq.	T. M. HOCKEN, Esq., M.R.C.S.E.

1871.

PRESIDENT.

MR. JUSTICE CHAPMAN.

VICE PRESIDENTS.

J. T. THOMSON, ESQ. | J. S. WEBB, ESQ.

COUNCIL.

DANIEL BRENT, ESQ.
ROBERT GILLIES, ESQ.
STUART HAWTHORNE, ESQ.
JOHN HISLOP, ESQ.
RICHARD OLLIVER, ESQ.
JAMES SMITH, ESQ.
REV. D. M. STUART.

HONORARY SECRETARY.

T. M. HOCKEN, ESQ., M.R.C.S.E.

HONORARY TREASURER.

W. D. MURISON, ESQ.

Extracts from the Laws of the Otago Institute.

3. From and after the 1st September, 1869, any person desiring to join the Society may be elected by ballot, on being proposed in writing at any meeting of the Society by two members, on payment of the annual subscription for the year then current.

4. Members may at any time become life members by one payment of ten pounds ten shillings, in lieu of future annual subscriptions.

9. An annual general meeting of the members of the Society held on the second Monday of July.

OFFICE-BEARERS OF THE NELSON ASSOCIATION FOR THE PROMOTION OF SCIENCE AND INDUSTRY.

1870-71.

PRESIDENT.

SIR DAVID MONRO.

VICE PRESIDENT.

THE RIGHT REVEREND THE BISHOP OF NELSON.

COUNCIL.

F. HUDDLESTON, ESQ. | T. MACKAY, ESQ.
F. W. IRVINE, ESQ., M.D. | ALEXANDER SCLANDERS, ESQ.
GEORGE WILLIAMS, ESQ.

TREASURER.

CHARLES HUNTER BROWN, ESQ.

CURATOR AND SECRETARY.

J. SMITH.

Extracts from the Laws of the Nelson Association for the Promotion of Science and Industry.

2. The Association shall consist of members elected by ballot, who have been proposed at a monthly meeting of the Society, and elected at the ensuing meeting.

3. Each member to pay a subscription of not less than one pound per annum, payable half-yearly in advance.

4. Ordinary meetings held on the first Wednesday in each month.

TRANSACTIONS.

TRANSACTIONS

OF THE

NEW ZEALAND INSTITUTE

1870.

I.—ZOOLOGY.

Art. I.—*On the New Zealand Rat.* By Walter Buller, F.L.S., F.G.S.

(With Illustrations.)

[*Read before the Wellington Philosophical Society, June* 25, 1870.]

According to native tradition and the accounts of the early colonists, there formerly abounded in New Zealand a small frugivorous rat, which has, within the last quarter of a century, become almost extinct. The extermination of this apparently indigenous species is generally attributed to the introduced brown rat (*Mus decumanus*), which now infests the country and devours everything that comes in its way; and the Maoris are accustomed to speculate, by comparison, on their own ultimate extinction in like manner before the stronger Anglo-Saxon race, which is fast gaining the ascendancy. "As the pakeha rat has eaten up the Maori rat, so will the pakeha kill the Maori," has already passed into a proverb.

Whether the so-called New Zealand rat was indigenous to the country, or whether it came with the first Maori immigrants, it is impossible now to determine. But one thing is certain, namely, that within the memory of the present generation of Maoris it abounded in such numbers as to constitute a staple article of animal food. Certain wooded districts were renowned for rats, and at particular seasons of the year, hunting parties, often a hundred strong, were formed, and trapping carried on in a systematic manner. On these occasions thousands of rats were captured and eaten, or potted down in their own fat for future use.

Even at the present day, in the investigation of title before the Native Lands Court, the trapping of rats in former times is often brought forward by the claimants, as one of the recognized acts of ownership on the part of the tribe so claiming, and in support of the original native title.

Considering these facts, and particularly the extreme scarcity of the New Zealand rat, the discovery of a genuine specimen is an interesting event in our local natural history. A small rat recently caught on Mr. Owen's estate, at Wangachu, and forwarded to me "in the flesh," has been identified by the Maoris of this district (where it was formerly very abundant) as the veritable *Kiore Maori*. I have accordingly preserved the animal entire, in spirits, and it is now deposited in the Colonial Museum. If (as seems highly probable) this rat should prove to be new to science, I propose to distinguish it as *Mus Novæ Zelandiæ;* and in order to place on record a description available for reference and comparison, I beg to offer the following notes, being the result of my examination of the fresh specimen.

Fur above bluish black; sides of nose, chin, throat, and underside of body and inner sides of limbs uniform bluish grey; ears, feet and tail dark brown; soles flesh brown. The ears are large, rounded and naked, and the fur covering the body is soft and glossy. The tail is elongate, scaly, and covered with minute spinous hairs. The upper side of both fore and hind feet covered with minute soft hairs, lengthening at the extremity of the toes, and curving over the claws, which are short, arched, sharp, brown in their basal portion and horn coloured at the tip. The fur of the back and sides with abundant lengthened hairs, but scarcely more rigid than the under fur; no long hairs on the under parts. Whiskers numerous, slender, flexible, the longest measuring two inches. Eyes moderate. The cutting teeth are yellow and perfectly smooth in front, the lower ones narrow, somewhat compressed and rounded in front. In certain lights the fur of the back has a purplish metallic lustre.

Adult female: six lateral ventral teats (three on each side); no pectoral teats.

Length, snout to base of tail	$6\frac{1}{2}$	inches.
,, tail	$7\frac{3}{4}$	,,
,, head	$1\frac{5}{8}$	,,
,, forefoot	$\frac{3}{4}$	,,
,, hindfoot	$1\frac{3}{8}$	,,

Unlike the common rat, this animal is perfectly free from odour or smell of any kind, which is probably due to the nature of its food, this consisting almost entirely of fruits and berries. At first glance it has more the appearance of a gigantic mouse than of a true rat; and on closer examination it presents a marked resemblance to the black rat (*Mus rattus*), which was formerly abundant in Britain, a phytophagous animal, feeding chiefly on herbs and seeds. As all naturalists are aware, this species has, in like manner to the New Zealand rat, become almost extinct in the British Isles, where it once abounded in great numbers. "Whether," writes Macgillivray, "the destruction of this animal has been effected by the larger and more ferocious brown rat, or like that of many tribes of the human species, has resulted from

MUS NOVÆ ZELANDIÆ Buller

MUS — Auckland Museum

the diminution of food, caused by the overwhelming increase of an unfriendly race, it is impossible to determine. It has, indeed, been alleged by many naturalists, that the brown rat has actually worried to death its less powerful relative; and, although this is mere conjecture, it is by no means improbable if we consider the character of that audacious animal, which has been known, when hard pressed, to attack even one of the lords of creation, when unusually hungry to gnaw the flesh of his defenceless offspring, and, when famished, to kill and devour its own kind."*

[This rat resembles *Mus fuscipes* of Waterhouse and Darwin (*Zool. of Voyage of H. M. S. "Beagle,"* Vol. i., p. 66), which inhabits the southern part of the Australian continent. This rat is said to be not uncommon on board steamers trading between New Zealand and that country, and maintains its position against the brown Norway rat (*M. decumanus*); the two species have been known to occupy different parts of the same ship.

An ocherous-coloured rat (a drawing of which, from a specimen in the Auckland Museum, has been forwarded by Captain Hutton), was obtained in New Zealand by Mr. J. Thorpe, in January, 1853, and appears to represent, in this country, a species introduced from Australia (*M. Gouldi*), from the Sydney district. (See Illustration.)

The illustration of the rat described by Mr. Buller is taken from a specimen preserved in spirits. The drawing supplied by Captain Hutton is taken from a stuffed specimen, and the following descriptive notes were sent with it:—

---

* Some discussion having taken place at the meeting of the Society, on the 25th June, when the above paper was read, as to "whether any native be now living who could really identify the native rat," (See *Proceedings W. P. Society*, p. 24,) I beg to add the following extract from a letter which I received from the Rev. T. Chapman, of Maketu, fifteen years ago:—"Relative to the New Zealand rat: I never possessed but one, and it hung up till it rotted away. I have neither seen nor heard of one for these ten years. The only description I can give you of it is that, as far as I remember, it was a true rat, only that *the ears were larger and rounded at the end.* As far as I know, their habits are the same as those of the Norway rat. * * * I was assured by a chief, of Tauranga, that previous to the introduction of the cat there was a rat, of a species larger than the Norway rat, in New Zealand, but that it was always very scarce." (November 5, 1855.)

Dr. Dieffenbach, writing in 1843, states,—"The indigenous rat has now become so scarce, owing to the extermination carried on against it by the European rat, that I could never obtain one. A few, however, are still found in the interior, viz., at Rotorua, where they have been seen by the Rev. Mr. Chapman, who described them as being much smaller than the Norway rat." (*App. Dieff. N. Z.*, p. 185.)

My friend, Major Nixon, informs me that when travelling in the interior of this province about sixteen years ago, the native who accompanied him killed a "Maori rat," which was feasting on the ripe fruit of the kiekie (*Freycinetia Banksii*). His description of this rat, from memory, accords exactly with the specimen which I have brought under the notice of the Society.

"Length, from snout to root of tail	. . . .	5·2 inches.
„ of tail	. . . .	3·3 „
„ of head	. . . .	1·38 „

Front feet 4-toed, hind feet 5-toed; thumb with a claw. Teeth yellow. Tail scaly and covered with short stiff white hairs to the end. Nose sharp pointed. Ears long (0·6 inch), rather pointed, yellowish brown, covered with minute hairs. Back and sides light reddish brown, inclining more to yellow on the shoulders and head. Snout, throat, cheeks, belly and feet dirty white. Fur below the hair slate blue.

"This specimen was presented to the Auckland Museum by Mr. J. Thorpe, in January, 1853."

Two skins of the same species of rat as that described by Mr. Buller have since been received from Mr. Moore, who obtained them on the East Coast of the Wellington Province.—Ed.]

Art. II.—*A List of the Lizards inhabiting New Zealand, with Descriptions.*

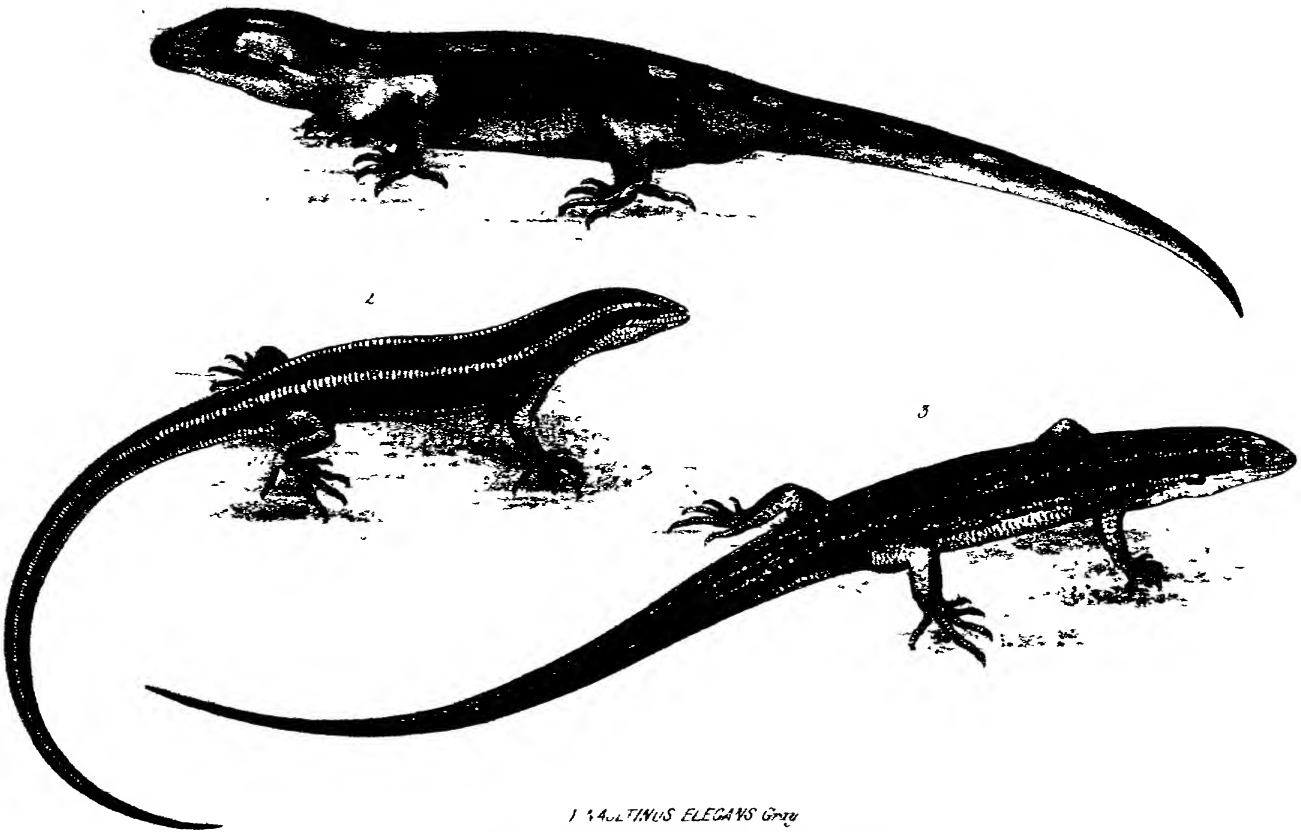
By Walter Buller, F.L.S., F.G.S.

(With Illustrations.)

[*Read before the Wellington Philosophical Society, October* 22, 1870.]

As some confusion has hitherto existed in the nomenclature and classification of the New Zealand lizards, I beg to lay before the Society a list of those already known to science, with a short description of each species for the purpose of identification. I am, however, of opinion that in some instances the differences which have been accepted by Dr. Gray and others as sufficient to mark distinct species, are due either to sex or age, and are not of any definite value as specific characters. There is, moreover, among this section, a great tendency to individual variation, and mere differences of colour, unless well marked and constant, are therefore a somewhat unsafe guide in the determination of species.

Further information on this branch of our local zoology is much to be desired. The Kawekaweau, a beautiful striped lizard, sometimes attaining a length of two feet, is still undescribed. It was formerly abundant in the forests north of Auckland, and is still occasionally met with. Mr. F. E. Maning, of Hokianga, recently obtained possession of a pair of live ones, but unfortunately for science, one of them was devoured by a cat and the other made its escape. A black lizard, described by Mr. Thomas Kirk as having been seen by him on the cluster of rocky islets off the west coast of the Great Barrier, known as Grey's Archipelago, will probably prove to be a new form. Descriptions of three new species, which I have ventured to name *Hinulia variegata*, *Mocoa striata*, and *Naultinus sulphureus*, are included in the following paper.



1 NAULTINUS ELEGANS Gray
2 MOCOA STRIATA Buller 3 ?MOCOA VARIEGATA Buller

J. Buchanan, lith. et del.

Printed at the Govt. Geo. Lith. Press, by J. Earle.

Genus HINULIA. Lygosma, part, *Dum. et Bib.* Le Keneux, part, *Cocteau.*

Diagnosis.—Head subquadrangular. Heel surrounded with granules.

Characters.—Frontal plate oblong. Rostral erect, triangular. Palate toothless, with a deep triangular notch in front. Body fusiform. Scales smooth, thin; the two central preanal scales larger than the rest. Tail tapering, roundish. Legs moderate. Toes 5-5, slender, compressed. Heel of the hind feet surrounded with granules.—*Brit. Mus. Cat.*, p. 74.

1. *Hinulia ornata*, Gray.

Bright pale brown, varied with black and white spots, sides with an irregular narrow pale streak above; scales with short black streaks, some black on each edge, white in the centre; ears moderate, rounded, simple edged.

A variety of this species in my possession, differs from Gray's type, in having the sides more variegated with black and white, the marginal streak on the sides distinct but interrupted, and the whole of the under parts irregularly and minutely spotted with brown. There is, moreover, a white spot margined with black between the eye and edge of upper jaw.

2. *Hinulia variegata*, Buller.

Reddish brown, beautifully varied with spots and markings of dark brown and white, disposed in regular series, and forming on the middle of the back and on the sides interrupted bands; tail dark brown, obscurely marked with paler; beneath greenish silvery, shaded with grey under the tail: form slender; tail very long and tapering; ears small, deep and rounded; toes long and slender.

Head ·6 in.; body 2·3; tail 4·4.

In one of my specimens there is a narrow line of yellowish white extending from the nostrils down the sides to the junction of the hind legs, and the dark brown of the sides is margined above with a similar line, although not so distinct.

Genus MOCOA. Lygosma, part, *Dum. et Bib.*

Diagnosis.—Rostral erect, triangular. Palate toothless.

Characters.—Head subquadrangular. Rostral erect, triangular, convex. Nasal lateral, nearly contiguous, supranasal none, frontoparietal separate or united into one. Palate toothless, nicked behind. Ears oblong, slightly denticulated in front, tympanum deep. Lower eyelid with a central transparent disk. Chin with several pairs of large shields. Body fusiform. Scales smooth, with three or four black streaks. Limbs 4, strong. Toes 5-5, compressed, unequal. Tail round, tapering, unarmed. Central preanal scales rather larger than the others.—*Brit. Mus. Cat.*, p. 80.

3. *Mocoa Zelandica,** Gray.

Pale brown, bronzed, with two narrow black edged bright streaks on each side, the lower one continued down the front of the legs; sides blackish; the fronto-nasal nearly contiguous, the fronto-parietal separate, similar to the parietal, nasal nearly contiguous; ears moderate, nearly circular, simple edged; pre-anal scales nearly equal; palpebral disk moderate.

Mokomoko of the natives.

4. *Mocoa Smithii*, Gray.

Pale brown, with three indistinct series of black spots and a pale streak on each side; sides black, varied; beneath whitish; limbs black spotted; nasal and fronto-nasal nearly contiguous, fronto-parietal and parietal nearly equal; ears open, simple-edged; pre-anal plates nearly equal; disk of the lower eyelid very large.

5. *Mocoa grandis*, Gray.

Black, closely yellow spotted, forming interrupted streaks; beneath whitish; soles of the feet black; ears rather large, roundish, with some granular scales in front; fronto-parietals distinct; disk of lower eyelid moderate, sub-central.

6. *Mocoa striata*, Buller.

Dark brown, obscurely marked with black and with two rows of small equidistant spots of white. From each side of the crown a broad stripe of white passes down the back and tail, leaving on the latter only a narrow, intermediate stripe of dark brown. These dorsal bands are narrowly margined above with black, and are succeeded below by an equally broad and distinct stripe of dark brown, which, commencing behind each eye, passes down the sides and widens on the tail. Beneath pale brown, spotted with darker, except on the chin which is almost white; fore feet brown, with an indistinct white stripe down the front; hind legs brown, obscurely spotted with white; tail slender and tapering; ears deep and round.

Head ·5 in.; body 2·2; tail 3·3.

Genus Naultinus. *Gray.*

Characters.—Toes free, base rather dilated, thick, rather compressed, end thinner, rather compressed, arched, clawed. Thumb similar, but its base shorter, clawed. Tail cylindrical, tapering, covered with granular scales. Body with a slight fold along each side beneath. Males? with two or three spines on each side of the base of the tail, and three or more transverse series of preanal pores, forming one and sometimes two patches.—*Brit. Mus. Cat.*, p. 169.

---

* *Hinulia ornata* and *Mocoa Zelandica* are the two species commonly described as *Tiliqua ornata* and *T. Zelandica*. Specimens of both are deposited in the Colonial Museum.

7. *Naultinus pacificus*, Gray.

Pale brown with irregular dark brown cross-bands and a dark streak on each side; front lower labial shield very large; the chin granular; scales uniformly granular, rather larger before and behind the vent.

The Common Tree Lizard. Moko-Papa of the natives.

8. *Naultinus elegans*, Gray.

Green, rather paler beneath; back sometimes varied with dark-edged white or yellowish spots; lower lips white; toes moderate; tail with a transverse series of compressed scales at each side of the base.

Green Lizard of the colonists. Kakariki of the natives.

Very beautiful varieties of this lizard are sometimes met with. A specimen, in the collection of the British Museum, has "a streak along the under lip, the ears, two arched stripes on the top of the head, irregular shaped spots on each side of the back and hind legs, an interrupted streak along each side of the body and tail, white, with a narrow black edge."

In some specimens there are only faint indications of these markings, while in others there is merely a lunate spot of pale yellow on each side of the crown. An example which I obtained many years ago, at Kaipara, had a stripe of golden yellow down the centre of the back, and a double series of transverse elliptical spots, on a ground of delicate pea green. A live specimen which I kept for several months, and which presented only a few obsolete yellow marks on the back, gave birth to three young ones, each differently marked but all having the double series of bright dorsal spots.

The purplish tinge noticed by Dr. Gray, in his description of the young, is only discoloration caused by the spirits. In fresh examples the green, although of different shades, is always pure.

This lizard, on being molested, emits a peculiar chattering sound, which the natives term "laughing" (*kata*), and of which they have a widespread superstitious dread. The "laugh" of a green lizard is enough to terrify the bravest warrior, and its occult power for evil is strangely believed in by all the tribes in every part of the country. The reptile itself, whether dead or alive, is an object of universal fear among them. Sir George Grey, in his very interesting *Account of an Expedition through the Interior*, 1849–50, states:— "I have seen twenty or thirty able-bodied men fly in a state of the most abject fright, and even take to the water, when pursued by a child with the dead body of a common green lizard in its hands."

9. *Naultinus Grayii*, Bell.

Green, paler beneath, sometimes varied with white spots; toes elongate; tail with four ovate, convex scales, forming an arched series on each side of the base.

In characterizing this species, as distinct,* Mr. Bell remarks that it greatly resembles *Naultinus elegans*, but adds:—"Upon a comparison of the two however, I find that they differ in the following particulars. In the present species the head is concave between the eyes and forwards nearly to the snout; in the other this part is quite plain; the scales of the head in this species are flat; in the other they are convex. The colour of this species is uniformly green, whereas *N. elegans* has several markings of a yellow colour, each distinctly bordered with black." In the *Cat. Brit. Mus.*, Dr. Gray records an example of this species, from Mr. Egerley's collection, as being "green, with three ovate white spots on each side of the back."

10. *Naultinus punctatus*, Gray.

Dark green, with very small scattered black specks, the size of a granule; beneath yellow-green; pre-anal pores in a triangular patch, with two series of pores under each thigh.

11. *Naultinus sulphureus*, Buller.

Uniform colour bright sulphur yellow, darker on the upper parts; abdomen bounded on each side by obsolete spots of paler yellow, dotted with black on the margins. There is a similar obsolete mark, 3 lines in extent, on each side of the crown. Soles of the feet pale brown. The granular scales are larger and more smoothly set than in *N. punctatus;* abdominal and pre-anal scales also larger. Interior of mouth dark blue.

Total length 6½ inches. From extremity of lower jaw to the vent 2·9 in.; thence to extremity of tail 3·6.

Hab.—Rotorua, North Island.

This fine species was discovered by Dr. Hector, during a visit, in company with His Excellency Sir George Grey, to the hot springs, Rotorua, in 1866. The original specimen is now deposited in the Colonial Museum, but it has unfortunately become partially discoloured. Other examples of this rare lizard have since been obtained.

The discovery is an interesting one, because it affords a fresh example of that mysterious natural law which adapts the colour of certain animals to the character of their habitat, for purposes of concealment and defence. This bright sulphur-coloured lizard lives in a region remarkable for its solfataras, silicious deposits, and sulphur crusts. Dr. Hochstetter, in his graphic account of the Rotorua Lake district, informs us that all around Pohuteo there are extensive sulphur deposits, and that in Arikiroa Bay, the yellow hue of the sulphur crusts which cover the ground, is visible at a great distance. He describes Tikitere as a whole valley of solfataras, bubbling mud pools, sulphur ponds, and hot springs, the ground around being covered with silicious

* *Zool. "Beagle,"* Rept. 27, t. 14, f. 2.

deposits and sulphur crusts, and the atmosphere impregnated with sulphuretted hydrogen.

The law of assimilative colouring, which, by affording protection to otherwise defenceless species, plays an important part in the struggle for life that is ever going on around us, is thus exemplified in the present instance.—The bright green tints of *Naultinus elegans*, enable it almost to defy detection amidst the evergreen foliage of *Leptospermum* and other shrubs; the marbled brown skin of *N. pacificus* is peculiarly adapted for concealment, as it clings motionless to the bark of a tree or hides in the crevices; and, in like manner, the colour of *N. sulphureus* seems specially fitted for a lizard inhabiting a sulphur-crusted and pumicestone region like the one described by Hochstetter.

12. *Naultinus granulatus*, Gray.

Pale brown, with irregular darker cross bands, with white edges in front; scales granular, moderate, those of under side larger; labial shields gradually smaller.

This species was originally noticed by Dr. Gray (*App. Dieff. N.Z.*), as a mere variety of *Naultinus pacificus*, but he has since admitted it to a distinct rank. The form appears to me of very doubtful specific value.

Naultinus brevidactylus and *N. maculatus* (Gray, MSS.) are probably mere varieties of the typical species, which is subject to much variation.

Genus Sphenodon.

13. *Sphenodon punctatum*, Sclater (= *Hatteria punctata*, Gray).

Olivaceous brown; sides and limbs with minute white specks; beneath yellowish grey; the spines of the nuchal and dorsal crests yellow, of the caudal brown; scales of the back, head, tail and limbs small, granular, nearly uniform; the irregular folds of the skin fringed at the top with a series of rather large scales; an oblique ridge of large scales on each side of the base of the tail, and a few shorter longitudinal ridges of rather smaller ones on each side of the upper part of the tail.

The sexes vary both in size and colour. The male is considerably smaller than the female, and the skin is of a brighter olive, yellowish on the under parts.

In the *Philosophical Transactions* for 1867, there is a very elaborate and exhaustive paper by Dr. Albert Günther, on the anatomy of this species; and an interesting paper on the same subject, by Dr. Knox, appears in the *Transactions of the New Zealand Institute*, 1869.

This is the Tuatara or Tuatete of the natives. I had a pair of live ones in my possession for many months, but could never induce them to eat. They were sluggish in their movements, and when molested uttered a low, croaking note. The male measured 13½ inches, and the female 16 inches. They were

obtained on the small island of Karewa, in the Bay of Plenty, where this large lizard is still very plentiful, although it is well nigh extinct on the mainland. Mr. Gilbert Mair, from whom I received them, furnished the following interesting notes:—"It was just daylight when we reached the island, and the Titis and other birds poured out of their nests underground in thousands. The whole place is completely honeycombed with their burrows, and you cannot move two steps without sinking to the knees in them. The tuataras are very plentiful. They live in holes under the big rocks, and can be only got at by digging. I suspect that, during a part of the year at least, they subsist largely on birds' eggs."

Mr. Sclater, the Secretary of the Zoological Society, in an article contributed to *Nature* (June 23, 1870), notices the acquisition, by purchase, of a living example of this remarkable lizard, and refers to it as the only one that had reached England alive since the publication of Dr. Gunther's admirable paper in the *Philosophical Transactions* (Part ii., 1867). This is evidently a mistake; for in the early part of last year, Dr. Hector forwarded, under care of Sir George Grey, a pair of live tuataras (male and female), one of which reached the Zoological Gardens in safety, and was afterwards figured in the *Illustrated London News.* These specimens were obtained by Mr. Gilbert Mair, together with those sent to me, on the Island of Karewa, above referred to, which he describes as distant about nine miles from Tauranga, about two acres in extent, and composed of large masses of scoria loosely jumbled together.

The Bay of Plenty natives assert that those found on the Rurima Rocks are of a different kind; and Mr. Mair adds, of his own knowledge, that those inhabiting East Cape Islet, about fifty miles to the eastward of Opotiki, are of a "bright green colour."

This reptile, which differs in some important structural characters from every other known saurian, and in its osteology is the most *bird-like* of extant lizards, was first described and figured by Dr. Gray under the name of *Hatteria punctata*, and has been generally designated so till lately, when (as Mr. Sclater informs us) "it was most fortunately discovered, that the generic term of *Sphenodon* had been previously applied to a specimen of its skull in the Museum of the College of Surgeons." This term has accordingly been substituted for *Hatteria*, which Mr. Sclater denounces as "vile and barbarous."

All the New Zealand genera of lizards have been re-named by Dr. L. J. Fitzinger, of Vienna, but I have thought it best to adhere to Gray's nomenclature. To prevent further confusion, however, I will give here the generic equivalents, viz.:—*Eulampus*, Fitz. = *Hinulia*, Gray; *Lampropholis*, Fitz. = *Mocoa*, Gray; *Hoplodactylus*, Fitz. = *Naultinus*, Gray. I ought also to mention that I have omitted from my list, a species of "house-gecko," described by

Dr. Fitzinger, as from New Zealand, under the title of *Dactylocnemis Wüllerstorfii*—so named in compliment to the Commander-in-chief of the "Novara" Expedition. I have not been able to obtain Dr. Fitzinger's description of this species, but it is very certain that there is no house-gecko indigenous to New Zealand.

Lampropholis moco, Fitz., is identical with *Mocoa Zelandica*, Gray.

[*Errata*, page 5:—Insert in *Diagnosis* of
HINULIA,—"Lower eyelid covered with scales."
MOCOA,—"Lower eyelid with a transparent disk."]

ART III.—*Critical Notes on the Ornithological portion of "Taylor's New Zealand and its Inhabitants."* By WALTER BULLER, F.L.S., F.G.S.

[*Read before the Wellington Philosophical Society, September* 17, 1870.]

IN offering to the Society some critical notes on the Rev. Mr. Taylor's recently published account of the New Zealand Birds,* I need scarcely say that I am actuated solely by a desire to serve the cause of Truth, which is the foundation of all human science. Mr. Taylor has devoted much labour and research to many of the subjects treated of in his book, and deserves thanks rather than criticism at the hands of his fellow colonists. But, as the reverend author will himself admit, it would be injurious to the interests of science, to allow his mistakes in describing the Ornithology of New Zealand, to go forth to the world uncontradicted. Indeed, to make a practical application of this truth, had some friendly critic reviewed the Natural History portion of Mr. Taylor's first edition of the work, published in 1855, it would have prevented the reproduction of some very flagrant errors in the new edition, fifteen years later. Moreover, I feel sure that my esteemed friend, Mr. Taylor, will, as a true lover of science, receive my critical remarks in the same spirit as that which dictates them.

1. The number of ascertained species belonging to the New Zealand Avifauna, is stated by Mr. Taylor at 136. Our last published lists contain the names of 160, a few of which, however, are of doubtful specific value.

2. The Koekoea (*Eudynamys taïtensis*) does not, "as is said by some," hibernate in New Zealand by "burying itself in the mud at the bottoms of rivers," but migrates to the warm islands of the South Pacific. The form of its wings is sufficient to determine the migratory nature of this bird.

* *Te Ika a Maui; or, New Zealand and its Inhabitants.* By the Rev. Richard Taylor, M.A., F.G.S. London: 1870.

3. The Weka (*Ocydromus australis*) is by no means "the largest kind of rail in New Zealand." The *Notornis* discovered by Mr. Mantell, in 1850, is more than twice the size of the largest weka. But the author contradicts himself by stating, in another place, that the *Notornis Mantelli* (Owen) is "the largest known rail in the world."

4. The Land Rail (*Rallus assimilis*) is incorrectly described as a bird "of a ferruginous colour." It closely resembles the banded rail (*Rallus pectoralis*), of Australia, as may be seen by inspecting the numerous examples in the Colonial Museum.

5. Under the head of FALCONIDÆ, the author places "*Falco Novæ Zelandiæ vel Circus Gouldii.*" Two birds belonging to distinct genera are thus associated as synonymes. The description evidently refers to the Harrier (*Circus Gouldii*).

6. In treating of the so-called "Night-hawk," the author has confused the nomenclature, for there is no such bird known as *Hieracidea Novæ Zealandiæ Gouldii.*

H. Novæ Zelandiæ is the Karewarewa, and *Circus Gouldii* the Kahu, of the natives.

7. There is no such Owl as *Athene albifrons.* The author evidently refers to *A. albifacies*, or Whekau of the natives.

8. *Heteralocha Gouldi*, the rare and beautiful Huia. The author omits the specific name, and the description of the bird is outrageously inaccurate. The tail contains twelve feathers, not four as stated; the bill is ivory white, not "bright yellow." It is the female that has the long, slender, curved bill, and not the male, and *vice versa.* The legs are black with a tinge of blue on their edges, and not "bright yellow." This bird certainly moves by a succession of hops, but I have failed to detect the resemblance of such movement to "that of the kangaroo."

9. It is true that the Tui (*Prosthemadera Novæ Zelandiæ*) becomes extremely fat at certain seasons of the year, but I entirely dissent from the assertion, that "when uncomfortably fat it pecks its breast and causes the oil to exude."(!) The account of its breeding habits also is incorrect, viz.: that it breeds three times in the year, laying in September three eggs, in December five, and in March, or autumn, six or seven "pure white eggs." The tui breeds only once a year, and lays generally three, and never more than four, eggs, which are white with obscure brown markings at the larger end, and minute widely scattered spots.

10. The Kotihe (*Pogonornis cincta*) is incorrectly described as having "a tuft of white feathers on either cheek and wing." The male of the species has an erective tuft of snow white feathers on each side of the head, but not on the cheek. There are no "white tufts" on the wings, but the secondary quills at their base, and their coverts, are white.

11. It is true that the Korimako (*Anthornis melanura*) has a brush tongue

and is a honey eater, but it nevertheless does not belong to the genus TRICHOGLOSSUS, which is a group of honey-eating parrots. The breeding habits of this species are also misrepresented, for I can endorse the following remark by Mr. Potts, in his excellent paper on the nidification of New Zealand birds (*Trans. N. Z. Inst.*, Vol. ii., p. 56),-- "We must have peered into scores of nests, in various parts of the country, but we have never yet been fortunate enough to encounter such a prize as one containing 'seven eggs, spotted with blue, upon a brown ground,' ascribed to this bird by the Rev. R. Taylor." The eggs of this species are generally four in number, white with a pinkish tinge and with reddish-brown spots, more numerous at the larger end.

12. The Matata (*Sphenœacus punctatus*) has a graduated, acuminate tail, and not "a tail composed of four long and four short feathers."

13. Under the head of "Troglodytinæ," there is a confusion of scientific names, and errors so obviously typographical that it would be unfair to hold the author responsible for them, except as regards the supervision of the printer's sheets.

14. By *Miro albifrons*, the author evidently means *Petroica albifrons*. "Miro" is a native name. It was adopted by M. Lesson, in 1831, to distinguish the genus, but the name did not stand, being superseded in the following year by Mr. Swainson's genus PETROICA.

15. There is no such bird as *Muscipeta Toitoi*. The author probably refers to *Petroica toitoi*.

16. The Tieke (*Creadion carunculatus*) has a vermilion wattle, or caruncle, pendent from the angle or corner of the mouth, on each side, and not "on either side of the head," as described.

17. *Aplonis Zelandicus*. The author entirely mistakes the bird. The Ground Lark (*Anthus Novæ Zelandiæ*) belongs to a totally different family.

18. The author's conjecture that the "light variety" of Kaka (*Nestor*) may be *Platycercus auriceps*, is far wide of the mark, as NESTOR is a very different genus to PLATYCERCUS, which comprises the various species of parrakeet found in New Zealand. The suggestion that the "Kaka-korako," or albino, belongs to the genus TRICHOGLOSSUS is even more unfortunate.

19. The Kea (*Nestor notabilis*) is described as a bird of "red plumage,"—a very inaccurate and insufficient description of this remarkably fine species.

20. The author is mistaken in giving the Parrakeet (*Platycercus pacificus*) a "band of red or yellow on the throat."

21. I have examined very many specimens of *Ardea matook*, but I have never seen one corresponding with the author's description, which gives this bird a "perfectly bald skull of a red colour."

22. The White Crane (*Ardea flavirostris*) has black legs, not "dark green," as described.

23. *Himantopus Novæ Zelandiæ* has a black bill, not a "red" one.

24. The description of the Paradise Duck (*Casarca variegata*) will not apply to either male or female of that species, neither of them having a "white breast."

25. Under the head of ALCIDÆ, the author has confused the generic and specific names in a very remarkable manner.

The members of this family found on the New Zealand coasts are,—*Aptenodytes Pennantii, Eudyptes pachyrhynchus, E. antipodes, Spheniscus minor*, and *S. undina.*

26. The last paragraph evidently refers to the Totoara, or Wood Robin (*Petroica albifrons*), although it is impossible to understand what the author means by "*Sylviadæ erythaca.*" There is a well-known genus, ERYTHACUS, established by Cuvier, of which the robin red-breast, of Europe (*E. rubecula*), is the type, but the New Zealand robin belongs to a different generic group.

ART. IV.—*Notice of a Species of* Megapode, *in the Auckland Museum.* By WALTER BULLER, F.L.S.

[*Read before the Wellington Philosophical Society, October* 22, 1870.]

IN a letter to the *Ibis*, dated 7th March, 1869, Captain Hutton, writing from Auckland, says,—"We have also in the Museum what is probably a new species of *Megapode*, from Nuipo, one of the Friendly Group."

On making an examination of this bird, I was inclined to refer it to one of the species described in the *Proceedings of the Zoological Society* (November, 1867), and in forwarding a description of the specimen to Dr. Finsch, of Bremen, I expressed that opinion. Dr. Finsch replies as follows:—"I am not able to make out the *Megapodius* mentioned by Captain Hutton, of which you kindly sent me a description. But if the name of the island, Nuipo, which I cannot find among the Friendly Group, is identical with Niafu or Niufu, the bird would be *Megapodius Pritchardi*, described in our *Ornithology of Central Polynesia*, p. 153. You do not mention the white on the longer upper tail coverts; otherwise the description agrees very well. From Hapai, one of the Friendly Group, Mr. Gray named the *Megapodius Burnabyi*, after an egg (!) received thence. *Megapodius senex* and *M. eremita*, Hartl. (*Proc. Z. S.*, p. 830), from Pelew and Echiquier Islands, of which I described the types, are different."

On referring to the description of *M. Pritchardi*, Gray, I find that our bird is distinguishable not only by the total absence of white markings on the upper tail coverts, but by other slight differences in the coloration, which may hereafter prove of specific value. The former species is thus characterized in *Orn. Centr. Polyn.* (Finsch and Hartlaub):—

Ad.—Alis, dorso medio tergoque rufescente-brunneis; capito, collo, inter-

scapulio, pectore epigastrioque sordide ardo-siaco plumbeis; abdomine medio, crisso et sub-caudalibus sordide griseo-flaventibus; gutture colloque sparsim plumosis; cauda rufescente-brunneo alboque varia; pedibus pallide rubentibus; rostro flavido, basi obscuriore.

Long. c. $11\frac{1}{2}''$; rostr. $9'''$; al. $7''\ 3'''$; tars. $1''\ 9'''$.

The following are my descriptive notes referred to in Dr. Finsch's letter:—

Megapodius —— ? Hab. Nuipo, one of the Friendly Islands. Native name *Malan.*

The whole of the plumage dark cinereous or slaty-brown, inclining to grey on the abdomen and under tail coverts; and tinged with reddish-brown on the back and on the upper surface of wings. The outermost primary is dark brown; the rest are ashy-grey with white shafts in their basal and middle portion, darkening into brown towards the tips. Bill dark horn colour. Feet dark brown; claws black, with horn-coloured edges. Irides ? (bright red in the stuffed specimen).

Extreme length $11\frac{1}{2}$ inches; wing from flexure $7\frac{1}{2}$; tail $2\frac{1}{2}$; tarsus 2; middle toe and claw 2; hind toe and claw $1\frac{3}{4}$; bill along the ridge $\frac{1}{2}$, along the edge of lower mandible 1 inch.

Plumage soft but compact. Wings short and rounded, indicating very feeble powers of flight. Legs strongly formed; toes furnished with ample claws; middle and outer nearly equal, inner $\frac{1}{2}$ inch shorter.

It is worthy of remark that both *Megapodius senex* and *M. eremita* rest on the authority of a single example; and in the absence of further specimens, the present bird would appear to have at least an equal claim to recognition as distinct. *M. Burnabyi*, as we have already seen, rests only on the authority of an egg from Hapai, and does not admit of any description, while *M. Stairi*, Gray, is not yet placed on the list of well-determined species.

If on further investigation the bird now under notice should prove to be new to science, it might appropriately be named *Megapodius Huttoni.*

An egg of this species, in the collection of the Auckland Museum, measures 3 inches in length by a diameter of $1\frac{5}{8}$. It is cream-coloured, of a regular elliptical form, and with a finely-granulate surface.

Art. V. — *On* Zosterops lateralis *in New Zealand, with an Account of its Migrations.* By Walter Buller, F.L.S., F.G.S., F.R.G.S.

(With Illustrations.)

[*Read before the Wellington Philosophical Society, November* 12, 1870.]

The genus *Zosterops* comprises a rather numerous group of closely allied species, with a wide geographic distribution; but, as a genus, it is somewhat isolated in its affinities. Mr. Gould in placing it, very properly, next to the

Australian honey-eaters, observes,—"I have been influenced by their approximation to these birds both in form and habits, and to which they exhibit a further degree of affinity in the form and structure of their nests, but not in the colouring of their eggs, which are always blue." But I would remark, that a stronger indication of this affinity than any mentioned by Mr. Gould, is to be found in the structure of the tongue, which is slightly pencilled at the tip, and proclaims at once the meliphagous habits of the group.

Members of this genus are scattered through Southern Africa, India, China, and Japan, but the species are most numerous in the sea-girt lands of Australasia and Polynesia, where each group of islands appears to have one or more species peculiar to itself. Mr. Gould records three well marked species from Australia, two from Lord Howe's Island, and two more from Norfolk and Phillip Islands. There is one species (*Zosterops flaviceps*) peculiar to the Fiji Islands, another (*Z. flavifrons*) to the New Hebrides Group, and another (*Z. conspicillata*) to the Ladrone or Marian Islands. Two species inhabit New Caledonia (*Z. xanthochroa* and *Z. griseonota*); one (*Z. cinerea*) is recorded from the Caroline Group, and another (*Z. melanops*) from the Loyalty Islands.

The New Zealand representative of the genus has been pronounced by competent authority to be identical with *Zosterops lateralis*, Lath. (=*cœrulescens*, Gould), an inhabitant of Tasmania, New South Wales, and South Australia.

Generic characters.—Bill moderate and slightly curved, with the culmen curved, and the sides compressed to the tip which is acute and emarginated; the gonys long and slightly ascending; the gape furnished with very short weak bristles; the nostrils basal and placed in a broad groove, with the opening closed by a lunate scale. Wings moderate; with the first quill very small, and the fourth and fifth equal and longest. Tail moderate, broad and slightly emarginated in the middle. Tarsi rather longer than the middle toe, and covered in front with broad scales. Toes rather long; with the outer toe rather longer than the inner and united at its base; the hind toe long, strong and armed with a long curved claw. (*G. R. Gray.*)

ZOSTEROPS LATERALIS, Latham.

The Silver-eye.

Tau-hou, Kanohi-mowhiti, Poporohe, and Iringatau, of the natives.

Zosterops cœrulescens, Gould.—*Hd. Bk. Birds of Australia*, Vol. i., p. 587.
Zosterops dorsalis, Vig. and Hors., in *Linn. Trans.*, Vol. xv., p. 235; Gould, *Birds of Australia*, Fol., Vol. iv., pl. 81.
Sylvia lateralis, Lath.—*Ind. Orn. Supp.*, p. lv.
Certhia cœrulescens, Lath.—*Id.*, p. xxxviii.

Fig 1.

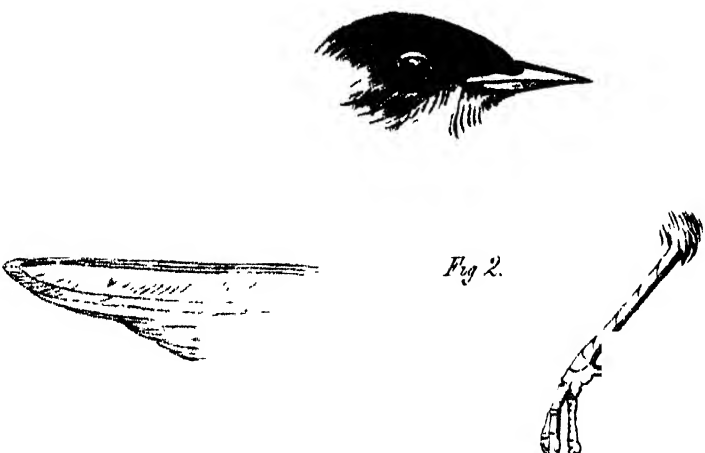


Fig 2.

Fig. 1. ZOSTEROPS CHLORONOTUS (after G.R. Gray.)
Fig. 2. ZOSTEROPS LATERALIS.

W. Fuller del. J.B. lith.

Printed at the Gov. Geo. Lith. Press, by J. Buchanan

Certhia diluta, Shaw.—*Gen. Zool.*, Vol. viii., p. 244.
Philedon cæruleus, Cuvier.
Meliphaga cærulea, Steph.—*Cont. of Shaw's Gen. Zool.*, Vol. xiv., p. 264.
Sylvia annulosa, var. b.—*Swains. Zool.*, Ill., 1st. ser., pl. 16.
Zosterops tenuirostris, Gould.—*Proc. Z. S.*, 1837, p. 76.

The story of the irregular appearance of this little bird in New Zealand has for years past been a fruitful topic of discussion among those who take an interest in our local natural history. Whether it came over to us originally from Australia, or whether it is only a species from the extreme south of New Zealand, which has of late years perceptibly increased, and has migrated northwards, is still a matter of conjecture. The evidence which, with Dr. Hector's assistance, I have been able to collect on this subject is somewhat conflicting, but I have myself arrived at the conclusion that the species, whether identical or not with the Australian bird which it closely resembles, is in reality an indigenous one. The history of the species, however, from a North Island point of view is very interesting and suggestive. It appeared on the north side of Cook's Strait, for the first time within the memory of the oldest native inhabitants, in the winter of 1856. In the early part of June of that year I first heard of its occurrence at Waikanae, a native settlement on the west coast, about forty miles from Wellington. The native mailman brought in word that a new bird had been seen, and that it was a visitor from some other land. A week later he brought intelligence that large flocks had appeared, and that the "tau-hou" (stranger) swarmed in the brush-wood near the coast; reporting further that they seemed weary after their journey, and that the natives had caught many of them alive. Simultaneously with this intelligence, I observed a pair of them in a garden hedge, in Wellington, and a fortnight later they appeared in large numbers, frequenting the gardens and shrubberies both in and around the town. They were to be seen daily in considerable flocks, hurrying forwards from tree to tree, and from one garden to another, with a continuous, noisy twitter. In the early morning, a flock of them might be seen clustering together on the topmost twigs of a leafless willow, uttering short plaintive notes, and if disturbed, suddenly rising in the air and wheeling off with a confused and rapid twittering. When the flock had dispersed in the shrubbery, I always observed that two or more birds remained as sentinels or call-birds, stationed on the highest twigs; and that on the slightest alarm, the sharp signal note of these watchers would instantly bring the whole fraternity together. The number of individuals in a flock, at that time, never exceeded forty or fifty, but of late years the number has sensibly increased, it being a common thing now to see a hundred or more consorting together at one time. They appeared to be uneasy during, or immediately preceding, a shower of rain, becoming more noisy and more restless in their movements. They proclaimed

themselves a blessing by preying on and arresting the progress of that noxious aphis known as "American blight" (*Schizoneura lanigera*).

They remained with us for three months, and then departed as suddenly as they had come. They left before the orchard fruits, of which they are also fond, had ripened, and having proved themselves real benefactors they earned the gratitude of the settlers, while all the local newspapers sounded their well-deserved praises.

During the two years that followed, the *Zosterops* was never heard of again in any part of the North Island; but in the winter of 1858 it again crossed the strait, and appeared in Wellington and its environs in greater numbers than before. During the four succeeding years it regularly wintered with us, recrossing the strait on the approach of spring. Since the year 1862, when it commenced to breed with us, it has been a permanent resident in the North Island, and from that time it continued to advance northwards. Mr. Colenso, of Napier, reports that it was first seen at Ahuriri in 1862. On his journey to Te Wairoa, in that year, he saw it at Aropauanui, and found its nest containing four fledgelings. The natives of that place told him that it was a new bird to them, they having first observed it there in the preceding year, 1861. The Hon. Major Atkinson, on the occasion of a visit, as Defence Minister, to the native tribes of the Upper Wanganui, in April, 1864, made enquiries on the subject, and was informed by the natives that the *Zosterops* had appeared in their district for the first time in 1863.

As far as I can ascertain, they penetrated to Waikato in the following year, and pushed their way as far as Auckland in 1865. Captain Hutton reports that in the winter of 1867 they had spread all over the province, as far north as the Bay of Islands, and in 1868 he writes,—"They are now in the most northerly parts of this island." That they have continued to move on still further northward would appear to be the case from the following interesting notes by Mr. G. B. Owen, communicated to me by Captain Hutton:—"On my passage from Tahiti to Auckland, per brig "Rita," about 300 miles north of the North Cape of New Zealand, I saw one morning several little birds flying about the ship. From their twittering and manner of flying I concluded that they were land birds, and they were easily caught. They were of a brownish grey and yellowish colour, with a little white mark round the eye. I saw several pass over the ship during the day, travelling northwards. I arrived in Auckland a few days afterwards, on the 20th May, when the so-called Blight Birds appeared here in such numbers, and I at once recognized them as the same."

This tendency of migration *northwards* appears to me quite inconsistent with the idea of the species having come to us from Australia.

Now let us ascertain something of its recorded history in the South Island. Mr. Potts, a most careful and experienced observer, writes to me:—

"I first observed it (in Canterbury) after some rough weather, July 28, 1856. I saw about half-a-dozen specimens, on some isolated black birch trees in the Rockwood Valley in the Malvern Hills." In the Auckland Museum there is a specimen of this bird, sent from Nelson by Mr. St. John (an industrious bird collector), in 1856. The skin was labelled "stranger," and in the letter accompanying it, Mr. St. John states that these birds had made their first appearance in Nelson *that winter* (the same in which they crossed to the North Island), and that "no one, not even the natives, had ever seen them before."

On a visit to Nelson in the winter of 1860, I saw numerous flights of them in the gardens and shrubberies. The results of very careful enquiries on the spot satisfied me that since their first appearance there, in 1856, they had continued to visit Nelson every year, arriving at the commencement of winter, and vanishing on the approach of warmer days as suddenly as they had come. On every hand the settlers bore testimony to their good services in destroying the cabbage blight and other insect pests.

About the middle of June, 1861, I met with small flocks of this bird on the Canterbury Plains, evidently on their passage northward. I first observed them in the low scrub on the broad shingle beds of the Rakaia, advancing in a very hurried manner, not high in the air, as migrations are usually performed, but close to the ground, and occasionally resting. But that this bird is capable of protracted flight is evidenced by the form of its wings, which are of the lengthened, acuminate character, common to most birds of passage.

During a visit to Dunedin, in the summer of 1860, the Rev. Mr. Stack observed numerous flocks in the gardens and thickets in the environs of the town. At this season they had disappeared from the Province of Canterbury and all the country further north. In the following summer (1861), I met with numerous stragglers in the northern parts of the Canterbury Province, and I understand from Mr. Potts, that since that time it has been a permanent resident there, increasing in numbers every year.

Mr. Buchanan, of the Geological Survey Department, informs me that he observed the *Zosterops* at Otago, on his first arrival there in 1851, five years previous to its appearance in the North Island; and the following extracts from letters, communicated to me by Dr. Hector, go still further to prove that the species is an indigenous one there, and is only new to the country lying further north.

Mr. Newton Watt, R.M., of Campbell Town (Southland), writes as follows:—"Paitu, a chief here, and I believe the oldest man in the tribe, says it was always here. Howell says that he first noticed them on the west coast, about Milford Sound, in the year 1832, in flocks of thirty or forty, but never noticed them here (Riverton) till about 1863, when he saw them inland and in smaller flocks. On my way back from Riverton, I was mentioning it at the Club at Invercargill, and a gentleman present told me he had first noticed

them, about eighty miles inland, about the year 1861, and that his attention was first called to them from the circumstance that they were gregarious,—a habit not common with New Zealand birds. At Campbell Town it appeared to be more scarce, being seen only in small flocks, varying in number from six to twelve. * * * In 1866 my sons noticed numbers of them among my cabbages, and observed that the cats caught many of them; and further, that whilst my cabbages in the three preceding years were infested with blight, in that year there was little or no blight upon them till very late in the season. They appear to migrate from this in the winter, or at any rate to be *scarce*."

Mr. James P. Maitland, R.M., of Molyneux, writes:—"From what I hear from old settlers of seventeen or eighteen years standing—whom I can trust as men of observation—I am convinced we have had the birds here for that time at any rate, although all agree that they have become much more numerous everywhere during the last seven years; and this year (1867) in particular, I observe them in larger flocks than ever. I confess I do not recollect noticing the bird until about six years ago; but the smallness of their number at that time, and the smallness of the bird itself, may easily account for its being unnoticed in the bush. The gardens seem to be the great attraction here, and they are the best hands I know at picking a cherry or plum stone clean!"

All my own personal enquiries at Otago, during my first visit there in February, 1865, led me to the same conclusion.

In the selection of its breeding home, this bird has manifested with us the same erratic tendencies: thus, for the first three or four years after its permanent location in the North Island, it wintered in the low lands and the districts bordering on the sea coast, and retired in summer to the higher forest lands of the interior to breed and rear its young. In the summer of 1865, a few stragglers were observed to remain behind all through the season, and in the following year they sojourned in flocks and freely built their nests in our shrubberies and thickets, and even among the stunted fern and tea-tree (*Leptospermum*) near the sea shore. From that time to the present it has ranked as one of our commonest birds all the year round; and, what is even more remarkable, it has very perceptibly increased in numbers, while most of our other insectivorous birds are rapidly declining and threaten ere long to be extinct.

To the philosophical naturalist the history of the *Zosterops* in New Zealand is pregnant with interest, and I feel that no apology is needed for my having thus minutely recorded it.

A specimen which I gave to the Rev. R. Taylor, and forwarded by him to the British Museum, was identified by Dr. J. E. Gray as *Zosterops dorsalis*. A notice thereof appeared in the *Annals of Natural History*, and in other scientific papers, and the supposed migration of the species from Australia to New Zealand excited considerable interest. *Zosterops dorsalis* is found to be identical with *Z. lateralis*, Latham, and Mr. Gould's *Z. cœrulescens* is merely a

synonyme of the same species. The last named writer informs us that "this bird is stationary in all parts of Tasmania, New South Wales, and South Australia, where it is not only to be met with in the forests and thickets, but also in nearly every garden." Dr. Finsch, of Bremen, to whom specimens of the New Zealand bird were forwarded by Dr. Haast, pronounced it *Zosterops lateralis*, Lath.; while Mr. Waterhouse, of the South Australian Museum, to whom Dr. Hector forwarded examples for examination, considers it distinct from the Australian species "although much resembling it."

The natives distinguish the bird as Tau-hou (which means "a stranger"), or Kanohi-mowhiti, which may be interpreted spectacle-eye or ring-eye. It is also called Poporohe and Iringatau, names suggested by its accidental or periodical occurrence.

By the settlers it has been variously designated as Ring-eye, Wax-eye, White-eye or Silver-eye, in allusion to the beautiful circlet of satiny-white feathers which surrounds the eyes; and quite as commonly the "Blight Bird," or "Winter-migrant."

I have frequently watched the habits of this little bird, and with much interest. As already stated it is gregarious, flying and consorting in flocks, except in the breeding season, when they are to be observed singly or in pairs. As soon as a flock of them alights on a tree, or clump of brush-wood, they immediately disperse in quest of food; and on a cautious approach, may be seen prosecuting a very diligent search among the leaves and flowers, and in the crevices of the bark, for the small insects and aphides on which they principally subsist. I have opened many specimens, at all seasons, and I have invariably found their stomachs crammed with minute insects and their larvæ. In some I have found the large pulpy scale insect (*Coccus* sp.), of a dull green colour, which is commonly found adhering to the leaves of the ramarama (*Myrtus bullata*); also small caterpillars, grasshoppers, and coleoptera, and occasionally the small fruity seeds of *Rubus australis* and other native plants. In our orchards and gardens it regales itself freely on plums, cherries, figs, gooseberries, and other soft fruits, but it far more than compensates for this petty pilfering, by the wholesale war it carries on against the various species of insects that afflict our fruit trees and vegetables. It feeds on that disgusting little aphis known as American Blight, which so rapidly covers with a fatal cloak of white the stems and branches of our best apple trees; it clears our early cabbages of a pestilent little insect that, left unchecked, would utterly destroy the crop; it visits our gardens and devours another swarming parasite that covers our roses and other flowering plants; to say nothing of its general services as an insectivorous bird. Surely in return for these important benefits, to both orchard and garden, the flocks of *Zosterops* may justly be held entitled to an occasional feed of cherries, or to a small tithe of the ripe fruits which they have done so much to defend and cherish!

This bird emits a soft plaintive cry, repeated at short intervals; but on the wing, and especially when consorting in a flock, it utters a rapid twittering note. During the breeding season the male indulges in a low musical strain of exquisite sweetness, but very subdued, as if singing to himself or performing for the exclusive benefit of his partner. This song is something like the subdued strain of the Korimako (*Anthornis melanura*), but much softer.

If shot at and wounded it generally manages to escape capture by scrambling nimbly off into the thicket, hiding itself and remaining perfectly silent till the danger has passed.

Frequent attempts have been made to keep it caged, but, although it will readily feed, I have never known it survive confinement many weeks.

Mr. Colenso observes that "when they retire to roost they sleep in pairs, cuddling quite close together like love-parrots; and before they fold their heads under their wings they bill and preen each other's head and neck most lovingly, uttering at the same time a gentle twittering note."

Mr. Potts informs me that, in Canterbury, this species begins nesting early in October. In one instance, within his own observation, the birds commenced incubation on October 16, the young were hatched on October 25, and left the nest on November 4. In the North Island the breeding season is somewhat later. As late as the 24th of December I met with a nest in the Taupo-Patea country, containing two perfectly fresh eggs.

The nest is a slight, cup-shaped structure, with a rather large cavity for the size of the bird, and is generally found suspended by side fastenings to hanging vines, or to the slender twigs of *Leptospermum*, *Olearia*, and other shrubs, and sometimes to the common fern (*Pteris aquilina*). The eggs are generally three in number (sometimes four), ovoiconical in form, and of a beautiful, uniform pale blue colour.

Nests of this species exhibit some variety, both as to structure and the materials of which they are composed. Of three specimens now before me, one is of slight construction and shallow in its cavity, composed externally of green coloured lichen, spiders' nests, the downy seed-vessels of the pikiarero (flowering clematis) and a few dry leaves; lined internally with long horse-hair disposed in a circular form. Another is of smaller size, more compact, composed externally of crisp, dry moss, and internally of grass bents with a few long hairs interlaced; while the third has the exterior walls constructed entirely of spiders' nests and stiff fibrous mosses, the former predominating, and the interior lining composed wholly of long horse-hair.

A specimen which I found suspended in a clump of creeping kohia (*Passiflora tetandra*) was composed externally of the pale green and rust-coloured lichen so abundant on the branches of dead timber, intermixed with spiders' webs, and lined inside with dry fibrous grasses, the whole being laced together with hair, the long straggling ends of which projected from every part

of the nest; and another which was obtained from the low brush-wood bordering on the sea shore was built of sheep's wool, spiders' nests, pellets of cow-hair, and fine seaweed, firmly bound together with long thread-like fibres, apparently the rootlets of some aquatic plant, and lined internally with fine grass bents and soft feathers. Sometimes the nest is constructed wholly of bents and dry grass.

Adult.—Crown, sides of the head, nape, upper surface of wings, uropygium and upper tail coverts bright yellowish olive; back and scapularies cinereous tinged with green; eyes surrounded by a narrow circlet of silvery white feathers, with a line of black in front and below. Throat, foreneck, and breast greyish white, tinged more or less with yellow towards the angle of the lower mandible; abdomen and under tail coverts fulvous white; sides pale chocolate brown. Quills and tail feathers dusky brown, margined with yellowish olive; lining of wings white, the edges tinged with yellow. Bill dark brown; under mandible whitish at the base. Irides, tarsi, and toes light brown.

Length 5 inches; extent of wings $7\frac{1}{2}$; wing from flexure $2\frac{1}{2}$; tail 2; tarsus $\frac{5}{8}$; middle toe and claw 9-16ths; hind toe and claw $\frac{1}{2}$; bill along the ridge $\frac{3}{8}$, along the edge of lower mandible $\frac{1}{2}$.

Young.—A young bird of this species brought to me on the 28th December had the colours paler than in the adult; the throat and breast pale cinereous grey; sides fulvous brown; the white eye circlet absent, the orbits being still destitute of feathers; tarsi and toes light flesh colour; bill pale brown; rictal membrane yellow.*

The characters given above as diagnostic of the genus *Zosterops* (Vigors and Horsfield) are taken from Gray's *Genera of Birds.* I have discovered, however, that the present species is in some respects aberrant from the type, and that Mr. Gray's generic characters are not sufficiently comprehensive.

The typical *Zosterops* has the wing moderate, the first quill *very small* and the fourth and fifth equal and longest; whereas the species under consideration has the wings long and pointed, the first quill only one-sixteenth of an inch shorter than the second, which is equal to the third, the fourth being scarcely shorter and the rest rapidly graduated. Moreover, the bill which is slightly curved in the typical species, is straight and acuminate in *Zosterops lateralis.*

These modifications of form, which will be at once apparent on reference to the accompanying figures (Plate III.), may, I think, be considered of sub-generic importance. At any rate, the peculiar adaptation of the wing in our bird to its migratory habits of life is deserving of special notice.

---

* Since the above paper was written, Archdeacon Stock, who, as the author well remembers, took a lively interest in the *Zosterops* on its first arrival in 1856, has furnished the following interesting note:—"I saw on Friday last, November 11, at Wilkinson's tea gardens (Wellington), what appeared to be a new variety of the Blight Bird. The white circle around the eye was not so distinct; and the head and throat were orange coloured."

Art. VI.—*On the Structure and Habits of the Huia* (Heteralocha Gouldi).

By Walter Buller, F.L.S., F.G.S.

(With Illustrations.)

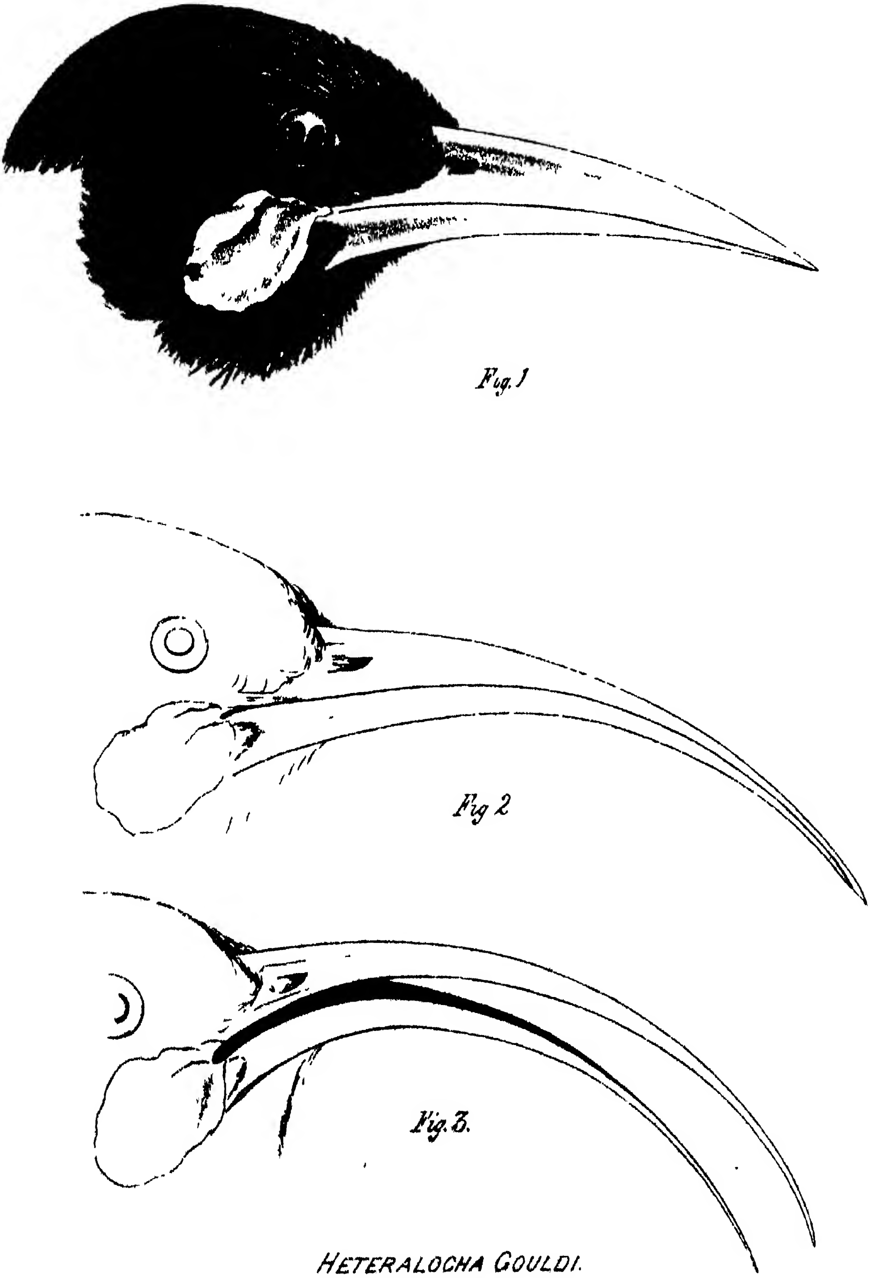
[*Read before the Wellington Philosophical Society, November* 12, 1870.]

An article in *Nature* (June 23) bearing the initials of a well-known naturalist, notices the arrival of a living example of the Huia (*Heteralocha Gouldi*) at the Zoological Society's Gardens, London. The specimen was a male bird, and the writer in describing the peculiarity in the form of the bill that distinguishes it from the female, observes,—"Such a divergence in the structure of the beak of the two sexes is very uncommon, and scarcely to be paralleled in the class of Birds. It is difficult to guess at the reason of it, or to explain it on Darwinian or any other principles."

Although Dr. Hector, with his usual good fortune, has succeeded in getting a fine series of specimens for the Colonial Museum, this bird undoubtedly ranks as one of our rarest and most valuable species. Erelong it will exist only in our museums and other collections, and, for the sake of science, it is important that everything connected with its natural history should be faithfully recorded and preserved. In the absence of any published account of its habits, beyond mere fragmentary notices, I have thought the subject of sufficient interest to justify my placing before the Society the following complete account of all that I have been able to ascertain respecting it. The peculiar habits of feeding, which I have described from actual observation, furnish to my own mind a sufficient "reason" for the different development of the mandibles in the two sexes, and may, I think, be accepted as a satisfactory solution of the problem.

Before proceeding to speak of the bird itself, I would remark on the very restricted character of its habitat. It is confined within narrow geographical boundaries, being met with only in the Ruahine, Tararua, and Rimutaka mountain ranges, with their divergent spurs, and in the intervening wooded valleys. It is occasionally found in the *Fagus* forests of the Wairarapa Valley, and in the rugged country stretching to the westward of the Ruahine Range, but it seldom wanders far from its mountain haunts. I have been assured of its occurrence in the wooded country near Massacre Bay (Province of Nelson), but I have not been able to obtain any satisfactory evidence on this point. It is worthy of remark that the natives, who prize the bird very highly for its tail feathers (which are used as a badge of mourning), state that, unlike other species which have of late years diminished and become more confined in their range, the Huia was, from time immemorial, limited in its distribution to the district I have indicated.

My first specimen of this singular bird (an adult female) was obtained in



HETERALOCHA GOULDI.
Fig. 1 Male
Fig. 2 & 3. Female.

W. Buller del. J.B. lith.

Printed at the Govt. Gen. Lith. Press, by J. Buchanan

1855, from the Wainuiomata Hills, a continuation of the Rimutaka Range, bounding the Wellington Harbour on the northern side,—the same locality from which Dr. Dieffenbach, nearly twenty years before, received the examples figured by Mr. Gould in his magnificent work on the Birds of Australia. I have since obtained many fine specimens, and in the summer of 1864, I succeeded in getting a pair of live ones. They were caught by a native in the ranges, and brought down to Manawatu, a distance of more than fifty miles, on horseback. The owner refused to take money for them, but I negotiated an exchange for a valuable greenstone. I kept these birds for more than a year, waiting a favourable opportunity of forwarding them to the Zoological Society of London. Through the carelessness, however, of a servant, the male bird was accidentally killed, and the other manifesting the utmost distress, pined for her mate and died ten days afterwards.

The readiness with which these birds adapted themselves to a condition of captivity was very remarkable. Within a few days after their capture they had become perfectly tame, and did not appear to feel in any degree the restraint of confinement, for, although the window of the apartment in which they were kept was thrown open and replaced by thin wire netting, I never saw them make any attempt to regain their liberty. It is well known, however, that birds of different species differ widely in natural disposition and temper. The captive eagle frets in his sulky pride, the bittern refuses food and dies untamable, the fluttering little humming bird beats itself to death against the tiny bars of its prison in its futile efforts to escape, and many species that appear to submit readily to their changed condition of life, ultimately pine, sicken, and die. There are other species again which cheerfully adapt themselves to their new life, although caged at maturity, and seem to thrive fully as well under confinement as in a state of nature. Parrots, for example, are easily tamed, and I have met with numerous instances of their voluntary return after having regained their liberty. This tamability of character was exemplified to perfection in the Huias.

They were fully adult birds, and were caught in the following simple manner. Attracting the birds by an imitation of their cry to the place where he lay concealed, the native, with the aid of a long rod, slipped a running knot over the head of the female and secured her. The male, emboldened by the loss of his mate, suffered himself to be easily caught in the same manner. On receiving these birds I set them free in a well-lined and properly ventilated room, measuring about six feet by eight feet. They appeared to be stiff after their severe jolt on horseback, and after feeding freely on the huhu grub, a pot of which the native had brought with them, they retired to one of the perches I had set up for them, and cuddled together for the night.

In the morning I found them somewhat recruited, feeding with avidity, sipping water from a dish, and flitting about in a very active manner. It was

amusing to note their treatment of the huhu. This grub, the larva of a large nocturnal beetle (*Prionoplus reticularis*), which constitutes their principal food, infests all decayed timber, attaining at maturity the size of a man's little finger. Like all grubs of its kind, it is furnished with a hard head and horny mandibles. On offering one of these to the Huia, he would seize it in the middle and, at once transferring it to his perch and placing one foot firmly upon it, he would tear off the hard parts, then throwing the grub upwards to secure it lengthwise in his bill, would swallow it whole. For the first few days these birds were comparatively quiet, remaining stationary on their perch as soon as their hunger was appeased. But they afterwards became more lively and active, indulging in play with each other and seldom remaining more than a few moments in one position. I sent to the woods for a small branched tree, and placed it in the centre of the room, the floor of which was spread with sand and gravel. It was most interesting to watch these graceful birds hopping from branch to branch, occasionally spreading the tail into a broad fan, displaying themselves in a variety of natural attitudes and then meeting to caress each other with their ivory bills, uttering at the same time a low affectionate twitter. They generally moved along the branches by a succession of light hops after the manner of the kokako (*Callæas cinerea*), and they often descended to the floor where their mode of progression was the same. They seemed never to tire of probing and chiselling with their beaks. Having discovered that the canvas lining of the room was pervious, they were incessantly piercing it, and tearing off large strips of paper till, in the course of a few days, the walls were completely defaced.

But what interested me most of all was the manner in which the birds assisted each other in their search for food, because it appeared to explain the use, in the economy of nature, of the differently formed bills in the two sexes. To divert the birds I introduced a log of decayed wood infested with the huhu grub. They at once attacked it, carefully probing the softer parts with their bills, and then vigorously assailing them, scooping out the decayed wood till the larva or pupa was visible, when it was carefully drawn from its cell, treated in the way described above, and then swallowed. The very different development of the mandibles in the two sexes enabled them to perform separate offices. The male always attacked the more decayed portions of the wood, chiselling out his prey after the manner of some woodpeckers, while the female probed with her long plient bill the other cells, where the hardness of the surrounding parts resisted the chisel of her mate. Sometimes I observed the male remove the decayed portion without being able to reach the grub, when the female would at once come to his aid, and accomplish with her long slender bill what he had failed to do. I noticed, however, that the female always appropriated to her own use the morsels thus obtained.

For some days they refused to eat anything but huhu, but by degrees they

yielded to a change of food, and at length would eat cooked potato and raw meat minced up in small pieces. They were kept supplied with a dish of fresh water, but seldom washed themselves although often repairing to the vessel to drink. Their ordinary call was a soft and clear whistle, at first prolonged, then short and quickly repeated, both birds joining in it. When excited or hungry they raised their whistling note to a high pitch; at other times it was softly modulated, with variations, or changed into a low chuckling note. Sometimes their cry resembled the whining of young puppies so exactly as almost to defy detection.

Dr. Dieffenbach, in forwarding his specimens of the Huia to Mr. Gould, in 1836, wrote,—"These fine birds can only be obtained with the help of a native, who calls them with a shrill and long continued whistle resembling the sound of the native name of the species. After an extensive journey in the hilly forest in search of them, I had at last the pleasure of seeing four alight on the lower branches of the trees near which the native accompanying me stood. They came quick as lightning, descending from branch to branch, spreading out the tail and throwing up the wings." I have had only a single opportunity of observing this species in its native haunts, and I was struck by the same peculiarities in its manners and general demeanour. In the summer of 1867, accompanied by a friend and two natives, I made an expedition into the Ruahine Ranges in search of novelties. After a tramp on foot of nearly twenty miles, through a densely wooded country, we were rewarded by finding the Huia. We were climbing the side of a steep acclivity, and had halted to dig specimens of the curious vegetating caterpillar (*Sphæria Robertsii*), which was abundant there. While thus engaged, we heard the soft flute note of the Huia in the wooded gully far beneath us. One of our native companions at once imitated the call, and in a few seconds a pair of beautiful Huias, male and female, appeared in the branches near us. They remained gazing at us only a few instants, and then started off up the side of the hill, moving by a succession of hops, often along the ground, the male generally leading. Waiting till he could get both birds in a line, my friend at length pulled trigger, but the cap snapped and the Huias instantly disappeared down the wooded ravine. Then followed a chevy of some three miles, down the mountain side and up its rugged ravines. Once more, owing to the dampness of the weather, the cap snapped and the birds were finally lost sight of. I observed that their mode of progression was similar to that of the kokako, but far more rapid. While in motion they kept near each other and uttered constantly a soft twitter. The tail was often partially spread, while the bright orange lappets were usually compressed under the rami of the lower jaw.

We camped that night near the bed of a mountain rivulet, in a deep wooded ravine, and soon after dawn we again heard the rich notes of a Huia.

Failing to allure him by an imitation of the call, although he frequently answered it, we crossed to the other side of the gully, and climbed the hill to a clump of tall rimu trees (*Dacrydium cupressinum*), where we found him. He was perched on the high limb of a rimu, chiselling it with his powerful beak, and tearing off large pieces of bark, doubtless in search of insects, and it was the falling of these fragments that guided us to the spot, and enabled us to find him. This solitary bird, which proved to be an old male, had frequented this neighbourhood, as we were informed by the natives, for several years, his notes being familiar to the people who passed to and fro along the Otairi track, leading to Taupo. On asking a native how the Huia contrived to extract the huhu from the decayed timber, he replied, "by digging with his pick-axe"—an expression which I found to be truthfully descriptive of the operation; and on dissecting this specimen I found an extraordinary development of the requisite muscles. The skin was very tough, indicating probably extreme age. The stomach contained numerous remains of coleopterous insects, of the kind usually found under the bark of trees, also one or two caterpillars. In the stomach of another, I once discovered seeds of the hinau (*Elæocarpus dentatus*) and the remains of a small earth grub. Dr. Dieffenbach states that in the stomachs of his specimens he found hinau berries, together with dipterous and coleopterous insects.

Of the nidification of the Huia nothing is at present known. I have been assured, however, by a native, that he once found the nest of this bird in the cavity of a tree, that it contained two young birds, a male and a female, and that they differed from the adults in having the wattles flesh-white instead of orange.

Mr. Gould, who was the first to characterize the genus (*Proc. Zool. Soc.*, Part iv., p. 144), was deceived by the great difference in the form of the bill, and treated the sexes as distinct species, naming them respectively *Neomorpha crassirostris* and *N. acutirostris*,—a very natural mistake, "many genera even," as Mr. Gould observes, "having been founded upon more trivial differences of character." Mr. G. R. Gray having determined their identity, proposed to substitute the specific name of *Neomorpha Gouldi*, in compliment to the original describer. The generic term has since been changed to *Heteralocha*, and the Huia continues to be the sole representative of this anomalous genus.

The head of the female as figured in *Nature* (confessedly only a copy), is quite out of all natural proportion to that of the male, and is apt to give a false idea of its relative size and thickness.

In the generality of specimens, and in the published drawings that have hitherto appeared, the bill is of a yellowish horn colour, but this instead of being natural is caused by the decomposition of the animal matter inside. I have succeeded in retaining the ivory whiteness of the bill, in preserved specimens, by treating them after the manner recommended by Waterton for

preserving the bill of the American toucan (see *Wanderings*, p. 103), that is to say, by removing with a sharp scalpel the whole of the inner substance, leaving nothing but the outer shell, which then retains its original appearance. The process is a tedious one, but the result amply repays the trouble.

The sexes are alike in plumage, and differ very slightly in size. The whole of the plumage is black, with a green metallic gloss; the tail with a broad terminal band of white. Bill ivory white, darkening to bluish grey at the base. Wattles large, rounded, and of a rich orange colour in the living birds. Legs and feet bluish grey; claws light horn colour.

In some examples the white at the end of the tail is tinged more or less with rufous, while in others the under tail coverts also are tipped with white.

Male.—Length 18¾ inches; extent of wings 22½; wing from flexure 8; tail 7½; bill along the ridge 2¾, along the edge of lower mandible 2¾; tarsus 3; middle toe and claw 2½; hind toe and claw 2.

Female.—Length 19½ inches; extent of wings 21; wing from flexure 7½; tail 7¼; bill along the ridge 4, along the edge of lower mandible 4⅛; tarsus 3; middle toe and claw 2¼; hind toe and claw 1¾.

Figures 1 and 2 (Plate IV.) represent the heads of the male and female which I had in my possession alive, and will give an accurate idea of the divergence of sexual character treated of above. Figure 3 represents a more highly curved form of the bill than is usually met with, and is taken from the dried head of a Huia given to me, many years ago, by a native who was wearing it as an ear ornament.

ART. VII.—*On the Katipo, or Venomous Spider of New Zealand.*

By WALTER BULLER, F.L.S., F.G.S.

[*Read before the Wellington Philosophical Society, November* 12, 1870.]

So little appears to be known of the natural history of the Katipo, or Venomous Spider of New Zealand, that I have deemed the following observations on its range and habits of sufficient interest to warrant my placing them before the Society.

The first scientific notice, so far as I am aware, of the existence of a poisonous spider in this country, was furnished by Dr. Ralph, formerly of Wellington, in a communication to the Linnean Society, in 1856. (See *Journal, Proc. Lin. Soc.*, Vol. i., Zool., 1856, p. 1–2.) Dr. Ralph's paper contained a short description of the full-grown spider, observations on its nesting habits, and an account of experiments which he had made in order to test the potency of its venom.

The native name, Katipo, signifies "night-stinger," (being derived from

two words, *kakati*, to sting, and *po*, the night,) and although more strictly applicable to the venomous spider, is often used to denote a wasp or other stinging insect.

The exact range of this spider—interesting as being the only poisonous vermin in New Zealand—cannot yet be accurately determined; but it appears to be rather local in its distribution, while its habitat is strictly confined to the sand-hills skirting the sea shore. Along the coast from Wainui to Waikanae (on the north side of Cook's Strait), it is excessively abundant. From Waikanae to Horowhenua it is comparatively scarce; but at the latter place, and for a few miles further north, it is said to be abundant. At Manawatu, and thence along the coast for twenty or thirty miles, it is very rare. At the mouth of the Wanganui River, again, it is very abundant, and a story is still current among the natives of the district about a fishing party, all of whom were bitten by this dreaded spider, and, in two cases, with fatal results. I was assured by Matene Te Whiwhi, of Otaki, that in former times a war party to which he belonged, on camping for the night near the mouth of the Wanganui River, had no less than ten men bitten before morning, some of whom suffered very severely. The Rev. Mr. Stannard informs me that he found the Katipo very plentiful, a few years ago, on the sea coast between Waitotara and Patea. On some parts of the Taranaki coast it is known to be very abundant. It is plentiful near the mouth of the Mokau River, but becomes scarcer as we go further north. It occurs, more or less abundantly, on the shores of the Bay of Plenty, but never beyond the littoral zone of sand dunes. It is also found, but less numerously, on the east coast of the Wellington Province. Major Heaphy obtained a specimen at Massacre Bay, near Nelson, in the South Island.

The notices of the Katipo which have hitherto been published contain many inaccuracies of description. In a very interesting paper communicated to the Auckland Institute, by Dr. Wright (*Transactions*, 1869, p. 81), the sea-shore Katipo is described as having a "dark glossy body with a marked *red spot* on the back." The Rev. R. Taylor, in his *Leaf of the Natural History of New Zealand*, writes thus:—"The Katipo—venomous spider—one kind red, and one black with a red spot upon its back." Major Heaphy expresses his doubts as to the existence of a red Katipo, as described by Mr. Taylor. (*Transactions*, 1869, p. 83.) Dr. Thompson, in his *Story of New Zealand*, says that there are two poisonous spiders—"the one found in the dry sea sand, having a bright red spot on its dark back, the other, found inland, being of a *yellow* colour." (p. 30.) According to another account, the inland Katipo has "a round black and shining body but without the spot." In his recent work, *New Zealand and its Inhabitants*, Mr. Taylor describes the Katipo as "a black spider very delicately formed, with a *red cross* on its back, surrounded with white spots; the female being entirely black." Dr. Hochstetter, who had

never actually seen the Katipo, describes it more correctly as "a small black spider with a *red stripe* on its back." Dr. Ralph, in the paper already referred to, mentions that this spider presents a very different appearance at different periods of its age, but he does not attempt to describe these progressive changes towards maturity. Having recently, through the kind assistance of Mr. Knocks, of Otaki, obtained a fine collection of live Katipos, in every stage of growth, together with their cocoons or nests, I am enabled to place before the Society a more detailed description of the species than has ever yet appeared.

There is a small extent of sand-hills near Waikanae, on the west coast, noted among the natives for the abundance of Katipo. A settler residing there, named Jenkins, assured me that he could without difficulty "fill a quart measure in less than a day." In 1857, I collected in that locality a considerable number of them, and kept them alive for several weeks in order to study their habits. And I may here mention a circumstance illustrative of the wonderful tenacity of life possessed by some of the *Arachnida.* I shut up a full-grown Katipo in a chemist's chip-box, on the 11th May, and placing it among other objects in my cabinet, it was overlooked and forgotten. I consequently did not open the chip-box again until the 8th October following, when I found the spider alive and active, and apparently none the worse for five months' fasting! As, however, in other instances I have known them perish at the end of a week for want of food, I am inclined to consider the above case corroborative of the Native account, that on the approach of cold weather the Katipo retires to a cell underground, and passes the winter in a torpid state, and that in this condition it may be handled with perfect impunity.

Mr. Taylor, in the published account already noticed, states that "the Katipo does not make any web," but this is a mistake, for on examining its haunts, it will often be found occupying a thick domed web, and on being captured, it may be observed spinning a fine thread of gossamer. This venomous spider may sometimes be found on the leaves of the pouaka, and occasionally in the crevices of drift timber lying high and dry on the sea beach; but its favourite resort is under the tufts of pingao (*Desmoschænus spiralis*), which grows in abundance on the sand dunes near the coast. On moving aside the long, overlapping leaves, the white web of the spider may be seen attached to the roots of the plant, and within or around it two or more of the venomous Katipo, the bright stripe on the back contrasting strongly with the black of the other parts.

The Rev. Mr. Chapman records a case in which the bite of this spider proved fatal to a girl who was bitten in the region of the abdomen; and he mentions another case, of an English lad who was bitten on the fleshy part of the thigh, and "was three months before he rallied, and probably another three before he fully recovered." (See *Transactions*, 1869, p. 82.) The natives on the west coast have assured me that among them, children have frequently

died from the effects of the bite. But in the generality of cases, and especially if the usual remedies are applied, the poisonous effects of the bite pass away in a few days, causing however much pain and lassitude while they last. The natives have several modes of treating a subject recently bitten, the most effectual one being to scarify the part and to bathe the patient in hot water. Another remedy in repute among them is to anoint the part affected with *kokowai*, or red ochre. This has the effect of reducing the swelling which almost immediately follows the bite, and alleviating the pain; and if the subject be robust and healthy no further inconvenience is likely to ensue. But if no such remedial measures are adopted, and the bite is neglected, very serious consequences may follow. According to the natives, the common symptoms are an aching pain in the part bitten, which soon becomes much swollen and inflamed; then a copious sweat, and a feeling of intense languor and depression of spirits. If not checked, this is followed by a convulsive contraction of the limbs, and the case then assumes a dangerous phase.

During my residence at Manawatu, some years ago, the natives brought me word that a woman had been bitten by a Katipo. I at once placed the case in the hands of the Native Medical Officer of the district, Batten Smith, Esq., to whom I am indebted for the following interesting notes:—

"April 5, 1863. At 2 p.m. I was called to see a woman named Marara, about fifty years of age, and belonging to the Ngatiwhakatere tribe. It appears that yesterday, about noon, whilst digging potatoes at Wirokino (near the sea coast) she was bitten by a Katipo on the left hip. In a few minutes after, she complained of 'pains all over her,' which were followed in the space of two hours by cold shiverings, lasting only for a few minutes and returning at irregular intervals up to the time of my visit. Her husband had applied hot roasted potato to the seat of pain, though without alleviating it. She has always been a strong and healthy woman. I found the left hip slightly swollen and tender on pressure, but neither any noticeable shining blush nor heat of the skin; the tongue clean all over; pulse through, full and strong, reaching only to 75; neither vomiting nor headache, cramps in the muscles of the stomach nor sore throat. Countenance anxious, but not bloated; pupils of the eyes natural, and not over sensitive to light. Pain great in *both* thighs, but greatest at the immediate seat of the bite, which had the same appearance as the prick of a needle or other fine instrument would produce. No swelling of either legs or feet.

"Treatment:—Solution of nitrate of silver 10 grains to 1 ounce of water, washed over the hip; and she was given the following mixture,—Carbonate of ammonia 2 scruples, laudanum 40 drops, chloric æther ½ drachm, peppermint water to 8 ounces. Two table spoonfuls to be taken every second hour.

"At 9 p.m. the rigors and pain having abated, she was given,—*Hyd. Chlor.* 3 grains, *s. s.*, and *Hst. Alb.* 1 ounce, *s. m.*

"April 6. Better, but tongue rather yellow. Repeated mixture with an increase of ammonia.

"April 7. Every bad symptom abated.

"April 8. Discharged well."

Dr. Wright, in describing a case within his own practice at Auckland, states that the patient, who was a stout strong man, within an hour after being bitten by a Katipo, on attempting to eat, found that he could not open his mouth, or was scarcely able to articulate in consequence of stiffness about the jaws. The symptoms grew rapidly worse, and the patient became faint and almost pulseless. His extremities were cold and flaccid, his respiration almost ceased, and his two medical attendants had fears that he was about to expire. Spirits of ammonia were applied to the wound, which had the effect of reducing the swelling and abating the pain; ammonia and water, afterwards combined with brandy, were administered in considerable doses. Under this treatment the patient gradually improved, and in two hours was able to return home, but for several days after was unable to return to his work. Dr. Wright concludes that "from the symptoms of this case, the man was powerfully affected by a narcotic and irritating poison, which being absorbed into the circulation, affected the heart, brain, and nervous system to a very considerable extent, almost amounting to fatal syncope,—that the stimulants, by exciting the heart's action, gradually aroused the excretory functions so as ultimately to remove the poison from the system."

Enough has been said to show that the bite of the Katipo, although seldom fatal, is very painful and distressing. It is important, therefore, that those whose avocations lead them to the sea shore, should be able to distinguish it readily from other spiders, and to know its haunts, so as to avoid them. I have satisfied myself that in common with many other venomous creatures, it only exerts its dreaded power as a means of defence, or when greatly irritated; for I have observed that on being touched with the finger, it instantly folds its legs, rolls over on its back, and simulates death, remaining perfectly motionless till further molested, when it attempts to escape, only using its fangs as the *dernier ressort.*

The cocoon, or nest of the Katipo, is perfectly spherical in shape, opaque, yellowish white, and composed of a silky web of very fine texture. The eggs are of the size of mustard seed, perfectly round, and of a transparent purplish red. They are agglutinated together in the form of a ball, and are placed in the centre of the cocoon, the exterior surface of which is sometimes encrusted with sand.

The Katipo undergoes the following changes in its progress towards maturity. In the very young state, it has the body white with two linear series of connected black spots, and an intermediate line of pale red; under parts brown; legs light brown with black joints. In the next stage, the fore

part of the body is yellow with two black "eye-spots," sides black with transverse marks of yellowish white; dorsal stripe bright red, commencing higher up than in the adult, and with the edges serrated; thorax dark brown; under parts black with an obscure spot of red; legs yellowish brown, black at their joints. At a more advanced age, the stripe on the back is brighter and is narrowly bordered with yellow, and there are some obscure markings on the sides. In this condition the thorax and legs are nearly black.

Adult Female.—Examples differ considerably in size, the body which is almost spherical, varying in development from the size of pigeon shot to that of a small green-pea. In the fully adult condition, this spider is a very handsome one, both in form and colour. In my largest specimens, the outspread legs, measuring across, cover a space of three-quarters of an inch. Thorax and body shining, satiny black. A stripe of bright orange-red passes down the centre of the body, the edges being tinged with yellow. At the anterior extremity, this stripe is broader and angular, and it is surmounted by an open, narrow mark of white in the form of a nail-head. Below this, and immediately above the junction of the thorax there are two divergent spots of orpiment yellow with white edges. Legs black, with the extremities inclining to brown. On the under surface there are two transverse spots of dark red. In some examples there is a dark line down the middle of the bright dorsal stripe, while in others the sides are ornamented with transverse marks of yellowish white. One of the specimens in my collection, more beautiful than the rest, has two triangular spots of yellow above the junction of the thorax, then two letter V marks with their angles joined, succeeded above by two similar but larger marks, their inner arms forming the nail-head which caps the bright dorsal stripe of red.

Adult Male.—The male is considerably smaller than the female. Body shining blackish brown, with an obscure narrow line of yellow down the centre of the back, broader towards the posterior extremity, and a similar interrupted line on each side; legs dark brown, with black joints.

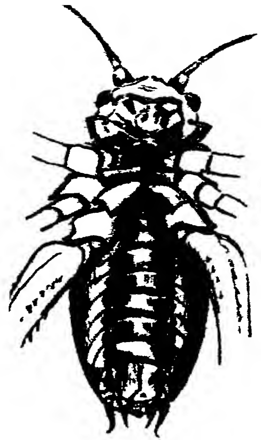
Art. VIII.—*Notes on the Genus* Deinacrida *in New Zealand.*

By Walter Buller, F.L.S., F.G.S.

(With Illustrations.)

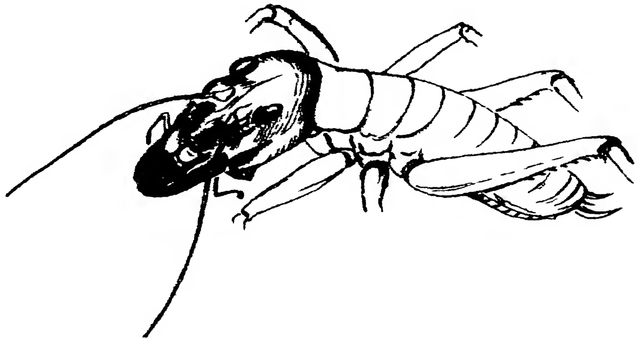
[*Read before the Wellington Philosophical Society, November* 12, 1870.]

[A portion of the following notes on a curious group of New Zealand insects appeared in the *Zoologist* for August, 1867. It has been considered advisable to reprint the paper after revision by the author, who now adds the description of an additional species.—Ed.]



1

2



1 DEINACRIDA RUGOSA, Buller (Male life size)

2 DEINACRIDA MEGACEPHALA, Buller, (Male)

3 DEINACRIDA RUGOSA (underneath view)

1. *Deinacrida heteracantha*, White. ("Weta-punga" of the natives.)

This fine species has a very limited geographical range. I have never heard of its occurrence south of the Waikato District, in the North Island. Formerly it was abundant in the forests north of Auckland; but of late years it has become extremely rare. The natives attribute its extermination to the introduced Norway rat, which now infests every part of the country and devours almost everything that comes in its way. One of these insects, in the collection of the late Dr. Sinclair, measured, with its hind legs and antennæ stretched out, fourteen inches; its head and body, exclusive of appendages, being two inches and a half. A specimen which I obtained in a pine forest, near the Kaipara River, more than thirteen years ago, and which is now deposited in the Auckland Museum, is even larger. The sexes differ considerably in size.

The Weta-punga appears to subsist chiefly on the green leaves of trees and shrubs. It climbs with agility, and is sometimes found on the topmost branches of the kahikatea and other lofty trees, but more generally on the low underwood of the forest. When disturbed it produces a clicking noise, accompanied by a slow alternate movement of its powerful hind legs. When taken it kicks or strikes backwards with these limbs, which are armed with double rows of sharp spurs; and, unless dexterously seized, will not fail to punish the offender's hand, the prick of its spurs causing an unpleasant stinging sensation. My brother-in-law, Major Mair, obtained some exceedingly fine examples of this insect in the Whangarei District. He found the killing of them, so as not to injure the specimens, a matter of some difficulty; and in one instance attempted to drown the insect in cold water, but found it after four days' immersion as lively and active as ever. In another case, a large Weta-punga which he had immersed in water almost boiling, and then laid aside in his insect-box as killed, revived in the course of a few hours, and appeared to be quite unharmed! A pair which I captured in a low belt of wood near the Wairoa, and secured in a pocket handkerchief, had eaten their way out and escaped before my return to the spot where I had left them carefully suspended.

2. *Deinacrida thoracica*, Gray. "Weta" of the natives.)

This species is very common in the North Island. It infests decayed wood, and particularly the dry stems of the tutu (*Coriaria ruscifolia*) and the branches of *Griselinia lucida*, into which it bores. During the night it may be heard emitting a peculiar snapping sound, especially when disturbed by the blaze of a camp fire in the woods.

The male may be readily distinguished from the female by its large head and long powerful jaws. The ovipositor (in the female) is about half an inch

long, and is slightly recurved. This insect is preyed on by the koheperoa (*Eudynamis taïtensis*), the kaka (*Nestor meridionalis*) and several other birds.

3. *Deinacrida megacephala*, Buller. (*Zool.*, 1867, p. 852.)

I bestowed this name on a new species, of which I had received several examples (of both sexes) from the woods in the neighbourhood of Wellington. The male of this species is characterized by a head and mandibles so large as to appear out of all proportion to the size of the body. (Figure 2, Plate V.b.) This exaggerated feature is wanting in the other sex, which, however, is distinguishable from *Deinacrida thoracica* by sufficiently obvious specific characters. The tibiæ are considerably thicker, and more strongly armed with lateral spurs, although not longer than in the other species; the thorax, which is ochreous-yellow marked with black in *D. thoracica*, is of uniform dark umber, narrowly margined with brown; the head of this species is almost entirely black, and the body, instead of being pale brown, as in the other, is deep reddish brown with transverse bands of black. The femora are marked on each side with three series of minute black spots, which are more conspicuous in the male. The following are the measurements of the male:—Head and mandibles, one inch; from anterior edge of thorax to end of abdomen one inch and three-sixteenths, the plate of the thorax measuring a quarter of an inch. The antennæ are four inches long; femur three-quarters of an inch; tibia one inch and three-sixteenths; tarsus and claws three-eighths of an inch. The vertex is much rounded or elevated, and perfectly smooth.

4. *Deinacrida rugosa*, sp. nov. (Figs. 1 and 3, Plate V.b.)

I propose this name for a species of which one example only (now deposited in the Colonial Museum) has yet been obtained.

This species is intermediate in size between *D. heteracantha* and *D. megacephala*, and possesses very distinct characters. The extreme length of the body is 1¾ inches, the thoracic shield measuring half an inch in length by three-quarters in width (following the curvature). Although a male specimen, the head is very small and rounded, measuring only half an inch in length, by three-eighths in width. The eyes are large and very prominent; the antennæ comparatively short, measuring scarcely four inches. Femur one inch; tibia one inch; tarsus and claws, half an inch. The edges of the thoracic shield are raised, and the surface is deeply punctured and indented. The posterior edges of the dorsal plates are raised, and the lower ones have a fringe of hard papillæ along their outer margin. All the plates are more or less punctured, and the whole surface presents a *roughened* appearance, which at once distinguishes the species from *D. heteracantha*, to which it more nearly approaches. Head, thorax, and body bright reddish brown, the edges of the plates darker;

thoracic shield and two succeeding plates marked with black. Antennæ and legs yellowish brown, the joints of the latter spotted with black. Under parts yellowish brown, darker on the edges of the abdominal segments.

My specimen was obtained in the Wanganui District, and was found underground.

Art. IX. — *Further Notes on the Ornithology of New Zealand.*

By Walter Buller, F.L.S., F.G.S., F.R.G.S.

(With Illustrations.)

[*Read before the Wellington Philosophical Society, November* 12, 1870]

In the Ornithological Notes which I had the honour on a former occasion to lay before the Society, I ventured to combat some of the views advanced by Dr. Otto Finsch, in regard to the characters and nomenclature of some of our New Zealand birds. That discussion, of which the present paper may be considered a continuation, was entered upon not in a spirit of controversy, but from a genuine desire on both sides to elicit the truth and to extricate the avifauna of this country from the confusion of nomenclature in which it had become involved. The critical experience which Dr. Finsch brought to bear on the subject, added to his very extensive knowledge of general ornithology, has proved of great value in determining hitherto little known or doubtful species. And I venture to believe that, owing to the advantage I possess as a local investigator, I also have been able to contribute in some degree to a better understanding of many of the species.

To me, personally, the discussion so commenced has been of service, by bringing me into friendly and direct communication wlth one of the most learned of Continental ornithologists; and in the last letter which I had the pleasure of receiving from him, Dr. Finsch frankly admits that my last paper has converted him on several points. For example,—that *Anthornis auriocula* is quite distinct from *A. melanura*, that *Rhipidura flabellifera* is clearly separable from *R. albiscapa* of Australia, that *Platycercus Fosteri* (Finsch) is of very doubtful specific value, and that Von Pelzeln's *Anthornis ruficeps* is merely a flower-stained example of *A. melanura*. On the subject of those "new species" which he has proved to have been already known to science, he remarks,—"I do not attack you in any way for publishing such species as new; on the contrary, I am glad to find that there is a zealous man working in our science who endeavours himself to contribute towards a better knowledge of the birds of that very interesting part of our globe. To a man engaged, as I have been, on ornithology for fifteen years, and working on the

greatest collections, it is in some cases easy to become convinced that a so-called new species has been published long ago elsewhere without having actually seen the type specimen. This has occurred to me often, not only with new species of others but with those published by myself." And, with the candor of a true man of science, he adds,—"I am always glad and thankful to learn whether one of my species is really good or not, and I was pleased to learn from Mr. Blanford, that a lark which I had described as new had no specific value."

The following notes have reference not only to the species treated of in my former paper, but relate also to Dr. Finsch's recently published account of the Parrots of New Zealand, as translated for the New Zealand Institute by Mr. R. L. Holmes.

1. Heteralocha Gouldi, Gray.

Dr. Finsch places this species in the family *Meliphagidæ* (*Journ. für Orn.*, 1870, p. 247), but states no reason for so novel a classification. Till its affinities are better known it must remain where Mr. Gould originally placed it, among the *Upupidæ*. All that is at present known of this remarkable species will be found collected in a paper read before the Wellington Philosophical Society. (*Vide ante*, p. 24.)

2. Anthornis auriocula, Buller.

Dr. Finsch, while admitting that this bird is distinct from *Anthornis melanura*, writes,—"Had you given formerly the measurements of *A. auriocula* I never would have doubted this species, but now I must say I cannot see the exact difference between this bird and *A. melanocephala*, Gray;" and in his recent paper on the Birds of New Zealand (*Journ. für Orn.*, 1870, p. 250), he remarks that it coincides so fully with the latter as to warrant a supposition that they are identical, "which appears more probable as both inhabit the Chatham Islands, a small group that can hardly be supposed to possess two species of such close resemblance."

I find no difficulty in pointing out characters that distinguish my bird from *A. melanocephala*, even more decidedly than from *A. melanura*.

Anthornis melanocephala, according to Gray's description, has the head steel black, and the neck, breast and upper tail coverts tinged with the same colour, and the wing coverts steel black margined with yellowish olive. In my *Anthornis auriocula* all these parts are of a uniform yellowish olive, there being merely a tinge of blue on the forehead as in the common species, *A. melanura*. In the former species the larger coverts, quills and tail feathers are blackish brown margined with paler or yellowish olive, whereas in my bird they are dusky brown.

3. ANTHORNIS RUFICEPS, Von Pelzeln.

Regarding this species, Dr. Finsch says,—"You are quite right in respect to *A. ruficeps*. The red colour on the face is caused by external influences, for my friend, Von Pelzeln, has washed the type in the Vienna Museum, and the red tinge has partially disappeared. But, looking at the specimen, I was bound to take it as a good species, not knowing the singular manner of feeding."

While this appears to be a full confirmation of my view that the stains were caused by the flowers of *Senecio cassinioides*, or some other plant, I consider it only fair to my friend, Dr. Haast, who first discovered the supposed species, to give the following extract from one of his letters to me:—"Concerning *A. ruficeps* I may state, I am more than ever convinced that it is a *good* species, having an orange forehead and being smaller and thinner than *A. melanura*. I have been lately to Mount Cook, where the *Senecio cassinioides* is growing and in blossom, but all the birds had *blue* heads notwithstanding."

The only inference, however, as it appears to me, fairly deducible from this fact, is that the red stains are produced not by *Senecio cassinioides*, but by the flowers of some other plant, and this in no degree establishes the validity of the species.

Dr. Finsch quotes a similar communication from Dr. Haast, dated March 26, 1870, but adds, "as this peculiarity of colouring, although only partly removed (in Von Pelzeln's specimen), proved an artificial one, it may be inferred with considerable certainty that its existence was owing to accidental outward influences; anyhow, the pollen with which these birds come in contact while seeking their food, contains colouring qualities producing a durable effect. *Anthornis ruficeps* ought therefore to be struck out of the list of New Zealand birds although Dr. Haast notes it as a genuine species of sub-alpine regions." (*Journ. fur Orn.*, 1870, p. 250.)

4. ANTHORNIS MELANURA, Sparrm.

As an instance of the mistakes into which the best closet naturalists almost inevitably fall when treating of a remote fauna, I may point out that Dr. Finsch enumerates *Anthornis melanura*, one of the commonest New Zealand birds, among the species belonging exclusively to the Chatham Islands. (See *Journ. für Orn.*, 1870, p. 243.)

5. XENICUS HAASTII, Buller.

This species is acknowledged by Dr. Finsch to be a good one, but he suggests that it ought to be referred to the genus *Certhiparus*; a view which I feel bound to reject. It possesses characters, however, which may entitle it to become the type of a new genus. *Xenicus gilviventris*, Pelz., is now added by Dr. Finsch to the list of species, although omitted in his former paper.

6. ORTHONYX OCHROCEPHALA, Finsch.

In my former notes (*Trans. N. Z. Inst.*, 1868, p. 108), I objected to the separation of *Mohoua ochrocephala* and *Certhiparus albicillus*, as in Dr. Finsch's list, and referred both species to the former genus.

The practice of adopting local native names to designate new genera, appears to me objectionable, inasmuch as it causes confusion in the general nomenclature. The name "Moho" has been selected for a genus of honey-eating birds inhabiting the Sandwich Islands. In New Zealand this name is applied generally by the Maoris to various species of aquatic rails, belonging to no less than three distinct genera. On the other hand, the appellation of "Mohoua" given by M. Lesson as the native name, and selected by him to distinguish the genus, has no existence in the Maori language, and its continued adoption would only perpetuate what is obviously a blunder. I therefore propose to restore the genus *Orthonyx* of Temminck, to which I can discover no tangible objection. And as I cannot see any valid reason why two species so closely allied both in structure and in habits should be separated generically, I have decided to refer both *Mohoua ochrocephala*, Gray, and *Certhiparus albicillus*, Lesson, to this genus.*

7. SPHENŒACUS FULVUS, Gray.

As the common species *Sphenœacus punctatus* is liable to some variation, both in size and plumage, I feel rather doubtful about the specific value of the bird described by Mr. G. R. Gray under the above name. A specimen in Dr. Hector's collection, at Otago, which I had an opportunity of examining in 1865, and which I supposed to be referable to Gray's *S. fulvus*, measured in length to end of tail $7\frac{1}{2}$ inches; wing from flexure $2\frac{1}{2}$; tail 4; tarsi $\frac{3}{4}$. The plumage generally was lighter and more fulvous than in ordinary specimens; the tail feathers dark brown edged with paler; bill, tarsi and toes very pale brown. Another specimen (minus the tail), in Mr. Lea's collection, was very similar although somewhat darker.

Whatever importance I might be inclined to attach even to trivial characters when constant, I should hesitate to accord to these occasional examples the rank of a distinct species.

* Since the above was written, I have received the July *Heft* of the *Journal für Ornithologie*, and am glad to find that Dr. Finsch has not only adopted my view as to the propriety of uniting *Mohoua ochrocephala* and *Certhiparus albicillus* generically, but has in fact anticipated me with regard to *Orthonyx*, by placing both species in that genus. It is gratifying to me to discover that, quite independently of each other, we have arrived at the same conclusion on so nice a point.

8. Gerygone assimilis, Buller.

In my former notes in reply to Dr. Finsch's paper in the *Ibis*, the following statement occurs:—"I am not aware that I ever met with *Gerygone assimilis* in the South Island. At any rate, I demur to being held responsible for wrongly named specimens which I have never had an opportunity of identifying." Dr. Haast has since written, reminding me that in a collection of skins from Canterbury, forwarded to me for examination in 1866, there was one which I identified as the young of *Gerygone assimilis*. I take this opportunity, therefore, of correcting a statement which implied that Dr. Haast was wrong in ascribing to this species a South Island range. At the same time it appears to me highly probable that Dr. Haast mistook the two birds. The specimen sent to me (which is still in my possession) is unquestionably a young bird, and although it is often difficult to distinguish between the young of closely allied species, I am still of opinion that it is referable to *G. assimilis*. The specimen which Dr. Haast forwarded to Germany, was "represented to be a female from Banks' Peninsula." Dr. Finsch, in noticing this specimen, states that it agrees in every respect with the description and figure of the true *G. flaviventris*, as given by Gray, except that the "yellowish growth on the under parts and tail coverts is weaker." (*Journ. für Orn.*, 1870, p. 254.) I perfectly agree with Dr. Finsch that such a bird is not separable from the old species; but the form which I propose to distinguish as *G. assimilis* is larger, and entirely free from the yellowish tinge on the under parts; and by Dr. Finsch's own showing he has never seen it.

Having examined a large number of their nests in various parts of the country, I found that, while they invariably exhibited the pensile character, they were as a rule referable to one or the other of two distinct types—the bottle-shaped nest with the porch or vestibule, and the pear-shaped form without the porch. This peculiarity coupled with the significant fact that in some instances the eggs were pure white, in others speckled or spotted with red, led me first to suspect the existence of two distinct but closely allied species, and the ascertained difference in size and colour which I have already indicated strengthened that view. In my *Essay on New Zealand Ornithology*, 1865 (p. 9), I described the two forms of nests, and proposed to distinguish the builder of the larger pear-shaped nest as *G. assimilis*. Although still of opinion that such a distinction is warranted, I am free to admit that the subject requires further investigation. My esteemed friend, Captain Hutton writes me:—"I have lately seen several good examples of the *porch* in the Riroriro's nest, but I think it easy to collect a series from no porch to the most developed, and it seems to me to be due more to accidental circumstances than to specific differences." It will be observed, however, that my correspondent does not appear to have actually found such a *series*, while in a former letter he states that although he had

examined a great many specimens, he had never yet met with the porch-like contrivance, and in an article recently contributed to the *Ibis* (July, 1870, p. 393), he remarks,—"I have never seen the porch described by Mr. Buller in his *Essay*."

Mr. Potts, in his interesting paper on the nests and eggs of New Zealand birds (*Trans. N. Z. Inst.*, 1869, p. 50), states that this species usually lays six eggs; but, so far as my experience goes, four is the normal number, although there are sometimes more. They differ somewhat in size, and vary in shape from the true ovoiconical to a slightly pyriform type. They are sometimes pure white, but more generally freckled with pale red, and are so fragile in texture as to bear only the most delicate handling. Mr. Potts accounts for the occurrence of white eggs on the supposition that they are the product of young birds; but I am more disposed to consider this, taken in connection with the slight difference in form and size, as further indicative of the existence of two distinct species.

Among the substances used as building materials by this bird, spiders' nests are always conspicuous; indeed, in some specimens the whole exterior surface is covered with them. The particular web chosen for this purpose is an adhesive cocoon of loose texture and of a dull green colour. These spiders' nests contain a cluster of flesh-coloured eggs, or young, and in tearing them off the bird necessarily exposes the contents, which it eagerly devours. Thus, while engaged in collecting the requisite building material, it finds also a plentiful supply of food—an economy of time and labour very necessary to a bird that requires to build a nest fully ten times its own size, and to rear a foster-brood of hungry cuckoos in addition to its own.

9. Petroica Dieffenbachii, Gray.

In characterising the above species (*Voy. Ereb. and Terr.*, Birds, p. 6), Mr. Gray states that it is "very like *Petroica macrocephala*, but is altogether smaller in size, and with the small and narrow bill of *P. toitoi*."

Petroica toitoi is confined in its range to the North Island, where it is very common. It may readily be distinguished from the other species by the pure whiteness of its under parts. The South Island is the habitat of *P. macrocephala*, and Auckland Island is included in its range on the authority of Mr. G. R. Gray. I obtained specimens at the Chatham Islands during a visit there in 1855, but I have failed to detect any such difference in examples from that locality as would justify the recognition of a distinct species, as proposed by Mr. Gray. I think it will be found necessary to expunge *Petroica Dieffenbachii* from the list of species, for I do not believe that it has any real existence.

10. Callæas olivascens, Pelzeln.

I cannot admit Herr von Pelzeln's bird described under the above name (*Trans. Zool. Bot. Soc.*, 1867, p. 317), to be a good species. The description is founded on a specimen collected at Auckland by Mr. Zelebor, and the diagnostic characters which distinguish it from *C. cinerea*, are the brownish olive colour of the back, wings and tail, the greyish olive of the under parts, its greater size, and the "dusky colour of the mouth caruncles." The dusky black colour of the wattles is worthless as a distinguishing feature, for these fleshy appendages, which are of a brilliant blue in the living bird, fade in death and entirely change colour in the dried specimen, becoming almost black. The sexes vary in size, and the peculiarity of coloration to which Von Pelzeln attaches specific value is characteristic of the female.

11. Platycercus Novæ Zelandiæ, Sparrm.

Our worthy President, the Hon. Mr. Mantell, in his Anniversary Address, refers to "the lamentable confusion inseparable from the attempt to determine species from the dried and distorted specimens in antipodean museums."

A striking instance of this is afforded in the number of "species" which stuffed examples of our common little Parrakeet (*Platycercus Novæ Zelandiæ*) have been made to represent.

The type of Mr. Gray's *Platycercus Cooki*, in the British Museum, is described as not distinguishable from ordinary specimens of *Platycercus Novæ Zelandiæ*, except that the red ear spots are rather faint, while the beak is a little stronger and blacker towards the point. Dr. Finsch states "that this distinction in the colour of the beak was taken by Gray as the chief ground for separating the species," and adds, that in another example of the so-called *Pl. Cooki*, in the Heine Museum, "the beak exhibits the usual colour."

An unusually small example of this bird was characterized by Prince C. L. Bonaparte as *Pl. Aucklandicus*. Another example, presenting some slight differences in the details of its colouring, was described by Verreaux as *Pl. Saisetti*; and another, of a lighter green plumage than ordinary specimens, became *Pl. erythrotis*.

Platycercus Rayneri, Gray, founded on a single specimen in the British Museum, does not differ at all in colour from the typical species, the only distinction being the "wider tail feathers."

Dr. Finsch, after enumerating a large series of specimens that had come under his inspection, very properly concludes:—"It appears to me impossible to make more than one well-defined species out of all the above." But at the same time, Dr. Finsch (with some apparent reluctance) raises Forster's bird to the rank of a distinct species, *Pl. Forsteri*, simply because of the accidental absence of the red thigh-spots. He observes, "Gray unites, improperly, this

bird with his *Pl. Aucklandicus*, although it is quite a distinct species." On the contrary, I think there is little room to doubt that both of the so-called species ought to be united to *Pl. Novæ Zelandiæ*.

Dr. Finsch's supposition that *Platycercus unicolor*, Vigors, in which the frontal spot is wanting, may be the young state of *Pl. Novæ Zelandiæ* is certainly incorrect; but as the specimen in the British Museum, on which the description is founded, is acknowledged to be "the only one known," I have not the least doubt that it is merely an accidental variety of the common species.

Like many other members of the large natural family to which it belongs, this species exhibits a strong tendency to variability of colour, and the slight differences which some of the ornithologists of Europe have recognized as sufficient specific characters, are of no value whatever. As a proof of this, I may here notice four remarkable examples that have come within my own knowledge in this country.

(1.) A specimen of *Platycercus Novæ Zelandiæ* brought to me by a native, in the Kaipara District, many years ago, had the whole of the plumage of a brilliant scarlet red.

(2.) A specimen obtained in the woods in the neighbourhood of Wellington, had the green plumage thickly studded all over with spots of red. This handsome bird was caged, and at the first moult the whole of the spots disappeared.

(3.) A young bird, brought to me from the nest, and not fully fledged, had the plumage of the body pale yellow, shaded with green on the upper parts, and the quills and tail feathers marked with red.

(4.) In the summer of 1863, I obtained a very beautiful variety of the common *Platycercus auriceps*, at Manawatu. I found it in the hands of a labouring settler, who had purchased it from the natives for something less than a shilling. Finding him unwilling to part with it, I tempted him with a guinea, and secured the prize. It was a bird of the first year, and presented the following appearance:—Frontal band crimson, vertex golden yellow; space around the eyes and a band encircling the neck green; head, shoulders and lower part of back red, the intermediate space variegated with red and green; quills dusky, obscurely banded with yellow, and margined on the outer vane with blue; wing coverts greenish yellow, barred and margined with red; tail feathers green, obscurely barred with yellow in their apical portion. Under parts green variegated with crimson and yellow, an interrupted band of the former colour crossing the breast. Like the spotted variety already mentioned, within a short time it commenced to moult, and was fast assuming the common green livery of the species, when it was accidentally killed. This specimen, which still exhibits traces of its original colours, belongs now to the type collection of the Colonial Museum.

I think I may venture to assert, that had any one of these "occasional

varieties" found its way into the National Collection of Great Britain, or into one of the great continental museums, it would have been honoured with all the distinctions of a good and true species!

12. NESTOR MERIDIONALIS, Gmelin.

Dr. Finsch describes in graphic terms the delight with which he gazed upon a live Kaka (*Nestor meridionalis*), in the Zoological Society's Gardens, London, and speculates on the speedy extinction of the species; and Mr. Gould, in the Appendix to his *Hand-book to the Birds of Australia* (p. 549), expresses a hope that some of the residents of New Zealand will "study and record the habits and economy of this bird before it be extirpated, and its name and a few stuffed skins alone left as an evidence of its once having existed." Although it cannot be denied that the Kaka is less common than it formerly was, it still exists in very considerable numbers in various parts of the country, and there is no present danger of the species becoming extinct. In the months of December and January, when the rata (*Metrosideros robusta*) is in flower, thousands of these birds are trapped by the natives, and preserved in their own fat for winter use. Partly owing to this cause, and partly to the extension of settlement, it is true that in some districts where in former years they were excessively abundant, their cry is now seldom or never heard; but in the wooded districts of the interior they are as plentiful as ever.

The cause of the rapid disappearance in these Islands of some species of birds, and absolute extinction of others, is a very interesting question. In a newly-colonized country, where the old fauna and flora are being invaded by a host of foreign immigrants, various natural agencies are brought into play to check the progress of the indigenous species, and to supplant them by new and more enduring forms, more especially in the case of insular areas of comparatively small extent. These agencies are often too subtle in their operation to arrest the notice of the ordinary observer, and it is only the ultimate results that command his attention and wonder. But in New Zealand some special cause, apart from this general law, must be assigned for the alarmingly rapid decrease of many of the indigenous birds. In the course of a very few years, species, formerly common in every grove, have become so scarce throughout the country as to threaten their extinction at no very distant date.

Various reasons have been suggested to account for this. The natives believe that the imported bee, which has become naturalized in the woods, is displacing the kaka, tui, and other honey-eating birds. One of the oldest settlers in the Hokianga District (Judge Maning), speaking to me on this subject said,—"I remember the time, not very long ago, when the Maori lads would come out of the woods with hundreds of korimakos hung around them in strings, now one scarcely ever hears the bird; formerly they swarmed in the northern woods by thousands, now they are well-nigh extinct." On

asking him his opinion as to the cause of this, he told me that he agreed with the Maoris, that the bee having taken possession of the woods, has driven the honey-eating birds away from the flowers, and practically starved them out; and he referred to the scarcity of the tui, another honey-eater, in support of this view.* But it must be remembered that both of these species subsist largely on berries and insects, and that the comparative failure of their honey food, even if granted, will not of itself account for the rapid decrease of these birds; while, on the other hand, the totoara (*Petroica albifrons*), and other species which do not sip flowers, are becoming equally scarce. It appears to me that the honey-bee theory is quite insufficient to meet the case, and that we must look further for the real cause. As the result of long observation, I have come to the conclusion that hitherto the chief agent in this rapid destruction of certain species of native birds has been the introduced rat. This cosmopolitan pest swarms through every part of the country, and nothing escapes its voracity. It is very abundant in all our woods, and the wonder rather is that any of our insessorial birds are able to rear their broods in safety. Species that nest in hollow trees, or in other situations accessible to the ravages of this little thief, are found to be decreasing, while other species whose nests are, as a rule, more favourably placed, continue to exist in undiminished numbers. As examples of this latter class, I may instance the kingfisher, which usually scoops out a hole for its nest in the upright bole of a dead tree, quite beyond the reach of rats, and appears to be more abundant now than ever; also the *Rhipidura*, *Zosterops*, *Gerygone*, and other small birds whose delicate nests are secured to slender twigs, or suspended among vines and creepers. And the ground lark, again, which nests in open grass or fern land, where the brown hawk (*Circus Gouldi*) keeps the rat well under control, has of late years sensibly increased being now very common. As a matter of fact, I have known a case in which half a dozen nests of the tui, within a radius of a hundred yards, were robbed by rats of both eggs and young.

In a letter which I had the pleasure of receiving from the Rev. T. Chapman, of Rotorua, some years ago, that gentleman states,—"Wild ducks were particularly numerous in this district on my arrival here: you saw them by dozens, —you hardly see them now by twos. I have no doubt we owe this to the Norway rat. There is a place on the Waikato River, some twenty miles below

* The following remark occurs in Mr. Travers' interesting lecture, "On the Changes effected in the Natural Features of a New Country by the Introduction of Civilized Races:"—"The kiore has been replaced, if not destroyed, by the European rat; the European honey-bee now swarms in our forests, taking the food of the meliphagous birds, which are already diminishing palpably in numbers, whilst the facility afforded by the immense epiphytical growth upon the forest trees enables the rat also to aid in this destruction by devouring the eggs and young birds."—*Trans. N. Z. Inst.*, Vol. ii., p. 312.

Taupo, where the chiefs occasionally assembled to act out two important matters,—to discuss politics and eat kouras (cray-fish). A few years after the Norway rat fully appeared, the kouras were no longer plentiful, and as the New Testament made Maori politics rather unnecessary, the usage of meeting no longer exists. The natives assured me that the Norway rat caught the cray-fish by diving. Rowing up the rivers you see little deposits of shells. Upon enquiry I found they were the selections of the Norway rat, who, by diving for these fresh-water pipis, provide a *kinaki* (relish) for their vegetable suppers."

In writing of the *Nestor hypopolius* (= *Nestor meridionalis*), Gould remarks,—"A very great dissimilarity, both in size and colouring, occurs in different examples of this species, so much so as to induce a belief, both in my own mind and in that of others, that they may constitute two species. * * * It will be a question for the colonists to determine if there be more than a single species, or if the differences seen in the skins sent to Europe are indications only of *local varieties*, and to what cause they may be due."

In my former notes (*Trans. N. Z. Inst.*, Vol. ii., p. 387), I stated that I had forwarded to Europe, for examination, specimens of a larger *Nestor* from the Middle Island, which differed considerably from the typical *Nestor meridionalis*. Mr. G. R. Gray, to whom I sent the skins, submitted them to Dr. Finsch for identification, and this naturalist refers to them in the *Journal für Ornithologie*, 1870, under the name of "Buller's *Nestor montanus*;" but this is a mistake, as I have never ventured to assign, or even to suggest, a specific name for this bird, although in writing to Mr. Gray I pointed out differences that might be deemed of specific value. In a letter to myself (under date July 13), Dr. Finsch observes,—"Mr. Gray sent me for examination the two *Nestors* [large and small] sent by you. I have inspected both with the greatest care, but I am not able to distinguish them as different species. In comparing only these two specimens, no one would hesitate to take them as distinct, but I have seen so many specimens of this *Nestor* that I would not be at all astonished to see examples differing even more than these. A specimen from the low-lands, sent by Dr. Haast, is quite inseparable from your Alpine *Nestor*. A general variation seems to be the rule in the genus *Nestor*. Scarcely two specimens are precisely and in every respect alike. This is not only the case with your common species, but also with the rare *Nestor productus*."

I fully admit the great variability of colour in specimens of *Nestor meridionalis*, and have myself directed attention to it (*vide Essay on New Zealand Ornithology*, p. 11); but this is a question, not merely of colour, but of two distinct races, a larger and a smaller, and both confined to separate geographic areas.

It appears to me that it is not of the least consequence to science whether

Dr. Finsch and I can agree to consider them good and true species, or merely local varieties of *Nestor meridionalis*, so long as they can be sufficiently distinguished. On no subject, probably, are the views of modern zoologists more divided, than on the question of what constitutes a species and what a variety. The definition of the term "species" is, after all, purely arbitrary, and is determined in a great measure by the individual opinion of every naturalist. Extreme views are held on both sides, one class of naturalists contending that it matters not how small the difference is between two allied species, provided it be constant, while there is a growing tendency among another class to group together a large number of slightly different species, usually considered distinct, as merely local or climatic varieties of one typical form. "Between these opposite views," to quote from a high authority, "there is certainly ample room for every shade of opinion. Every naturalist, indeed, has his own views on the matter. The fact is, that the amount of difference requisite to establish specific distinctness between two sets of individuals is, as has been well maintained by an eminent writer whose views are adverse to the real existence of species, *a matter of opinion*, and we should therefore be very careful in blaming writers whose ideas on this point may be at variance with our own."

Of the two classes of "lumpers and splitters," as they have been respectively termed, numerous examples might be given from the ranks of the best ornithologists. As an instance of the former, however, I may mention that Dr. Finsch has united, under *Conurus pertinax*, the species named *C. æruginosus*, *C. chrysogenys*, *C. xantholæmus*, *C. ocularis*, and *C. chrysophrys*. (*Papagien*, Vol. i., p. 506). It is not for me to say that a naturalist of Dr. Finsch's experience is wrong in this decision; but we have it, on the authority of Mr. Sclater, Secretary to the Zoological Society, that two of these forms, *Conurus xantholæmus* and *C. chrysophrys*, "living side by side in the Society's gardens, are very distinct species and certainly not to be confounded together," (*Proc. Zool. Soc.*, 1867, p. 588.)

"Many years ago," says Mr. Darwin, "when comparing and seeing others compare, the birds from the closely neighbouring islands of the Galapagos Archipelago, both one with another, and with those from the American mainland, I was much struck how entirely vague and arbitrary is the distinction between species and varieties. * * * Even Ireland has a few animals, now generally regarded as varieties, but which have been ranked as species by some zoologists. Several most experienced ornithologists consider our British red grouse as only a strongly marked race of a Norwegian species, whereas the greater number rank it as an undoubted species peculiar to Great Britain." He further states that few well marked and well known varieties can be named which have not been ranked as species by at least some competent judges, and he summarises thus:—"Certainly no clear line of demarcation has as yet been drawn between species and sub-species—that is, the forms which in the opinion

of some naturalists come very near to, but do not quite arrive at, the rank of species; or, again, between sub-species and well marked varieties, or between lesser varieties and individual differences."*

Mr. Sclater, in his review of Gould's *Monograph of the Trochilidæ*, observes,—"We have never been able to draw the line between a species and a climatic variety, nor do we believe it is possible so to do. We therefore do not complain of Mr. Gould having given specific names to certain local forms, if it can be shown that they are invariably distinguishable by constant characters."† And another well known naturalist, Mr. A. R. Wallace, in writing on the Pigeons of the Malay Archipelago says,—"A permanent local variety is an absurdity and a contradiction, and if we once admit it, we make species a matter of pure opinion, and shut the door to all uniformity of nomenclature;" and he holds that where the difference, however trivial, is constant, the so-called varieties must be regarded as distinct species.

Practically, as it seems to me, it matters little whether these closely allied forms be characterized as species, races, or varieties, the true object of all nomenclature being to aid the student in the systematic arrangement of all existing organisms according to their natural affinities. But the too common practice of confounding well marked local forms on the mere supposition of specific identity, without actual examination and comparison, is a positive injury to the cause of science, and cannot be too strongly condemned. It is not only fatal to scientific accuracy, but renders it almost hopeless to arrive at correct conclusions on the geographical distribution of species, a subject of the highest interest to the philosophical naturalist.

13. NESTOR ESSLINGII, De Souancé.

What is *Nestor Esslingii?* asks one of my correspondents. The question, though simple enough in itself, is not easily answered. The only specimen extant, so far as I am aware, is the one in the British Museum (which I have never had an opportunity of examining), and the several accounts given of the bird by those who profess to describe it, are so much at variance that local naturalists may well acknowledge themselves at fault respecting it.

M. de Souancé, the original describer of the species, says:—

"Le Nestor dont nous allons donner la description est, sans contredit, l'oiseau le plus remarquable de la collection Masséna. Intermédiaire entre le *N. hypopolius* et le *N. productus*, ce magnifique Perroquet réunit, dans son plumage, des détails caractéristiques de ces deux espèces. Coloration générale semblable à celle du *N. hypopolius*."

Mr. Gould, in the Supplement to his *Hand-book to the Birds of Australia*, says of this species,—"A single specimen only of this magnificent Parrot has

* *Origin of Species*, p. 60. † *Ibis*, 1862, p. 73

come under my notice; and this example is perhaps the only one that has yet been sent to Europe. It formerly formed part of the collection of the Prince D'Essling, of Paris, but now graces the National Museum of Great Britain. It is in a most perfect state of preservation, and is without exception one of the finest species, not only of its genus, but of the great family of parrots. The native country of this species is supposed to be New Zealand; but I, as well as M. de Souancé, have failed to learn anything definite on this point. In size it even exceeds the great kaka (*Nestor hypopolius*), which it resembles in the form of its beak, while in its general colouring it closely assimilates to *Nestor productus*."

Dr. Finsch, on the other hand, states in his *Monograph*, that *Nestor Esslingii*, De Souancé (of which the type is in the British Museum), is in size and general colour the same as *Nestor meridionalis*, but has the breast ash grey with brown terminal margins, and a broad yellowish white transverse band straight across the belly. Further on he speaks of *both* the original specimens from the Massena Collection being in the British Museum, and states that "they appear to be the only ones known." He adds, that he was not able to make such an examination of them as he wished, owing to their being in hermetically closed glass cases, but quotes Souancé, to the effect that the red marks on the inner vane of the quills and tail feathers are precisely as in *Nestor meridionalis;* whereas Mr. Gould distinctly says that while the tail feathers in *N. meridionalis* and *N. productus* are strongly toothed on the under surface with red, "in *Nestor Esslingii* no such marks occur, the toothing on the inner webs of the primaries is not so clear and well-defined, and the light coloured interspaces are more freckled with brown."

As stated by Mr. Gould, there is no certainty about the type specimen of M. de Souancé having come from New Zealand. Dr. Finsch, however, regards it positively as a New Zealand species, and cites Dr. Haast as his authority. "No traveller (he observes) speaks of this rare bird, and only from a remark of Dr. Haast's does it appear that it really still exists. He says, in his interesting treatise on the kakapo (*ver Handel des Kaiserl, Zool. Bot. Ver. Zer Wien.*, 1863, p. 116),—*Nestor Esslingii* is still to be seen in the forest districts, living on the berries of the numerous Alpine shrubs and on the roots of Alpine herbs,—the only remark we possess about the species." But Dr. Haast has since written to me, asking what *Nestor Esslingii* is, and I gather from his correspondence that he mistook another bird (the large Alpine *Nestor*, which Dr. Finsch considers a mere variety of *N. meridionalis*) for the true *Nestor Esslingii.* There is, consequently, no positive authority for considering this a New Zealand species.

Not having access to the type specimen, and left in utter confusion as to its real characters by the discrepancies to which I have adverted, it is impossible for a local naturalist to hold any decided opinion respecting it. But assuming

Dr. Finsch's description to be strictly correct,- that it most nearly resembles *Nestor meridionalis*, from which it is only distinguishable by the broad yellowish white band across the under parts of the body, and considering the extreme tendency in that species to variability of colour, I should be inclined to regard the British Museum bird as an accidental variety of the common Kaka. Among the numerous abnormally coloured examples which I have seen, from time to time, varying from an almost pure albino to a rich variegated scarlet, I remember one which, although like the common bird in its general plumage, had a broad *longitudinal* band of yellowish white on the abdomen. The specific identity of this specimen with *Nestor meridionalis* was unmistakable.

14. NESTOR SUPERBUS, Buller.

Diagnosis.—Latere inferiore, capitis lateribus, torque nuchæ, tergo caudæque tectricibus et superioribus et inferioribus puniceis; pileo, pectore, humeris alarumque tectricibus superioribus flavis, alis albido-flavis; cauda cinereo-flava.

Dr. Finsch's remark that my *Nestor superbus* approaches nearest in colour to *N. Esslingii* and *N. productus*, does not tend to diminish the confusion which already exists. As we have already seen, this author makes the yellow bellyband almost the only distinguishing feature between *N. Esslingii* and *N. meridionalis*. Gould gives the following description of the Phillip Island bird (*Nestor productus*).—General colour of the upper surface brown; head and back of the neck tinged with grey, the feathers of these parts, as well as of the back, margined with a deeper tint; rump, belly, and under tail coverts deep red; cheeks, throat, and chest yellow, the former tinged with red; shoulders, on their inner surface, yellow tinged with rufous olive; tail feathers banded at the base with orange-yellow and brown; the inner webs of the quill-feathers at the base and beneath with dusky red and brown; irides very dark brown; bill brown; nostrils, bare skin round the eye, and the feet dark olive-brown.

A glance at the diagnostic characters above (as quoted by Dr. Finsch) will show that my *Nestor superbus* is a very differently coloured bird to either of these species.

15. NESTOR OCCIDENTALIS, Buller.

Dr. Finsch disallowed this species, on the supposition that it was the large Alpine *Nestor* from the South, which he pronounces a mere variety of *Nestor meridionalis*. This surmise was a mistake; but, in a letter to me, he states that he is still inclined to believe that *N. occidentalis* is only another "variety" of the common species.

16. NESTOR NOTABILIS, Gould.

This fine species is not quite so scarce as Dr. Finsch supposes. In referring to the two examples sent home by Mr. Mantell (the first pair received in Europe), he observes that they may be regarded "as the last of this extinct, or very nearly extinct, species;" but further on he mentions, on the authority of a private letter, the arrival of two specimens at the Vienna Museum.

As this bird inhabits the slopes of the Southern Alps, and is driven down to the plains only during very severe winters, it is not frequently met with; but explorers, like Dr. Haast, who have visited its Alpine haunts, report it comparatively common. A zealous friend in the back Mackenzie Country has obtained, at various times, no less than eight live specimens for me, but in every instance some accident has occurred to them *in transitu*, or they have managed to escape. I am informed that another pair of live ones are now on their way, and I trust that these may reach me in safety, for it would be of the highest interest to study the habits of a species at present so imperfectly known.

A specimen obtained by Dr. Menzies in the Otago Province, and presented by him to Sir George Grey, is now deposited in the Colonial Museum at Wellington.

17. APTERYX AUSTRALIS, Shaw.

The first example of the *Apteryx* of which there is any record was obtained in New Zealand, about the year 1813, by Captain Barclay, of the ship "Providence," and afterwards deposited in the collection of the late Lord Derby. This bird was first described, under the above name, by Dr. Shaw (*Nat. Misc.*, Vol. xxiv., pls. 1057, 1058), and afterwards, at greater length, by Mr. Yarrell, in the *Transactions of the Zoological Society* (Vol. i., p. 71, pl. 10). On the 10th December, 1850, a series of specimens was exhibited before the Zoological Society of London, when Mr. Bartlett pointed out characters which, as he contended, established the existence of two species hitherto confounded under the specific name of *Apteryx australis* (*Proc. Zool. Soc.*, 1850, p. 276). Mr. Bartlett stated, at this meeting, that an *Apteryx* belonging to the late Dr. Mantell having been placed in his hands by that gentleman, he had remarked its dissimilarity to ordinary examples, and that after a careful comparison with a number of other specimens he had come to the conclusion that it was a new species. On comparing Dr. Mantell's bird, however, with the original specimen in the Earl of Derby's collection, he found that they were identical. He accordingly referred his supposed new species to *Ap. australis*, and distinguished the more common bird as *Ap. Mantelli*—"A humble effort," as he says, "to commemorate the exertions of Walter Mantell, Esq., to whom we are indebted for so many valuable discoveries in

the natural history of New Zealand." The characters which distinguish it from Shaw's *Ap. australis* are,—"its smaller size, its darker and more rufous colour, its longer tarsus which is scutellated in front, its shorter toes and claws which are horn coloured, its smaller wings which have much stronger and thicker quills; and also in having long straggling hairs on the face."

Mr. Bartlett stated further, that the *Apteryx* belonging to Dr. Mantell was collected by his son, in Dusky Bay, whence the original bird, figured and described by Dr. Shaw, was also obtained, and that so far as he had been able to ascertain, all the known specimens of *Ap Mantelli* were from the North Island.

In a "Report on the present state of our Knowledge of the Species of *Apteryx*," by Drs Sclater and Hochstetter, read at a meeting of the British Association, in September, 1861, and published for general information in the *New Zealand Gazette*, in May, 1862, the following observation occurs respecting *Ap. australis*:—"In fact, the species is so closely allied to the *Ap. Mantelli* as to render it very desirable that further examples of it should be obtained, and a rigid examination instituted between the two. For the present, however, we must regard this form of *Apteryx* as belonging to the southern portion of the Middle Island."

Mr. Gould, in the Appendix to his *Hand-book to the Birds of Australia* (p. 568), retains the original name for this species, but remarks:—"If Mr. Bartlett's view be correct, it is probable that the bird figured by me is the one he has named *Ap. Mantelli.*"

In my *Essay on the Ornithology of New Zealand*, 1865 (*Trans. N. Z. Inst.*, Vol. i.), I stated that only two examples of *Ap. australis* had been recorded (those noticed above), but Dr. Otto Finsch, in his review of my *Essay*, (*Journal für Ornithologie*, 1867, p. 331) observes:—"Our knowledge of *Ap. australis*, Shaw, is not confined to the two examples referred to by Mr. Buller. The Leiden Museum possesses one also, and there is a very fine specimen in the Imperial collection at Vienna."

Never having seen the four examples of *Ap. australis* thus mentioned as existing in European collections, I cannot presume to offer any positive opinion respecting them; but having examined a large series of specimens in New Zealand, some forty in number, of all ages and collected from all parts of the country, I have no hesitation in saying that (excluding, of course, the well-known *Apteryx Owenii*) all of them are referable to one and the same species. Having also carefully inspected the drawings illustrative of the specific distinctions between *Ap. australis* and *Ap. Mantelli* (*Proc. Zool. Soc.*) and examined the characters on which Mr. Bartlett grounded his new species, I am strongly of opinion that it will be found necessary to drop *Apteryx Mantelli* as a species, and to refer all the examples thereof to the true *Ap. australis*.

Mr. Bartlett draws the following distinction as to the colouring of the two supposed species :—"*Ap. Australis:* Colour pale greyish brown, darkest on the back. *Ap. Mantelli:* Colour dark rufous brown, darkest on the back." The above descriptions are applicable, the former to the female and the latter to the male of the common species.

Mr. Bartlett, in giving his measurements of the two birds, properly observes that the entire length, being taken from skins, is of very little value ; but the difference in the general proportions (amounting to two inches in the length of the bill) is also characteristic of the two sexes, the female being considerably larger than the male.

The condition of wing, ascribed by Mr. Bartlett to *Ap. australis*, "with soft slender quills" (as figured in the *Proc. Zool. Soc.*), is that of the young bird. The length of the "straggling hairs on the face" varies in almost every individual, and is certainly of no value as a specific character.

Mr. Bartlett's strongest point is that one species has the tarsus *scutellated* in front, while in the other it is *reticulated*. The descriptive and comparative notes which I have collected on this point are too lengthy to be given here, but they will appear in my forthcoming work on the Birds of New Zealand. To summarize, I may state that I have found so great a diversity of character in the size and arrangement of the tarsal scales in different examples, that I do not attach very much importance to those peculiarities of structure in this respect, which Mr. Bartlett deems of specific value. I have observed a gradation from a regular series of quadrangular scutes, protecting the whole anterior portion of the tarsus, to a reticulated surface of large irregular scales, those towards the distal end being broadest. The latter condition appears to be characteristic of the immature bird, the scales being detached from each other and not imbricated, or with overlapping edges, as in the adult.

Figures 1 and 2 (Plate XII.b.) represent the wing and foot in an ordinary adult female of the common species, the so-called *Ap. Mantelli.*

18. ARDEA SACRA, Gmelin.

It is satisfactory to find that our Blue Heron (*Ardea matook*) has been finally identified with *Ardea sacra* of Gmelin ; and that we are thus enabled to purge our list of so gross a corruption of the Maori, as "matook" for "matuku."

19. RALLUS PECTORALIS, Lesson.

I think we are perfectly justified in considering our *Rallus assimilis* identical with *R. pectoralis*, the more so as Drs. Finsch and Hartlaub have been compelled to reduce their *Rallus Forsteri* to a synonyme of that species.

In a paper communicated to the Zoological Society of London (November 26, 1869), they observe :—"It is certainly disagreeable to kill one's own

children, but as to *Rallus Forsteri* we are fully convinced of our error. In a set of specimens from the Pelew Islands, some had the rufous pectoral band, in two others it was entirely wanting, and in one bird there was only to be seen a faint trace of it." They, therefore, conclude that their so-called *Rallus Forsteri* is only a variety of age or season of the well known *R. pectoralis*, Lesson.

I have examined a large series of specimens in New Zealand, and although I have never seen one in which the pectoral band was absent, I have found it varying, both in extent and depth of colouring, from a narrow interrupted line of rufous brown to a broad zone of rich chestnut. In other respects all the specimens are very much alike.

20. OCYDROMUS NIGRICANS, Buller.

Dr. Finsch is of opinion that the new Rail discovered by Dr. Hector in the Otago Province, and described by me in the *Transactions of the New Zealand Institute* (Vol. i., p. 111), is identical with *Gallirallus fuscus*, Du Bus, which, he states, Mr. Gray confounded with *G. brachypterus*, Lafr.

It is natural to enquire how, if *Gallirallus fuscus* be a well established species, it has hitherto been omitted from the List of New Zealand Birds? Although Dr. Finsch states that *G. brachypterus* (of which Gray considers *G. fuscus* a synonyme), "never occurs in New Zealand," he includes it in his enumeration of New Zealand Birds, *Journal fur Ornithologie*, 1867, pp. 346-347.

21. PHALACROCORAX NOVÆ HOLLANDIÆ, Stephens.

In his review of my *Essay*, Dr. Finsch observes (*Journ. für Orn.*, 1867, p. 339),—"*Graculus carboides* cannot be separated as a species from our European *G. carbo*, Linn." Referring to this, my friend, Captain Hutton, writes to me,—"I think Dr. Finsch is wrong in uniting our *Graculus carboides* with the European *G. carbo*. I was well acquainted with the latter in all seasons in the Crimea, and I am pretty well acquainted with *Carboides* up here (Auckland), and I feel sure that they are different."

I agree with Captain Hutton in his view as to the specific distinctness of the two birds, but the so-called *G. carboides* must be referred to *Phalacrocorax Novæ Hollandiæ*, as originally described by Stephens (*Cont. of Shaw's Gen. Zool.*, Vol. xiii., pl. 1, p. 93). It was noticed by Mr. Gould, and described (from Australian specimens) under the name of *P. carboides* in the *Proceedings of the Zoological Society* (Part v., p. 156). It appeared again under the same name in his great work on the Birds of Australia, where he states that it "exceeds in size its prototype, the *Phalacrocorax carbo* of Europe." In his more recent *Hand-book*, Mr Gould has rectified the nomenclature, making his so-called *P. carboides* a synonyme of *P. Novæ Hollandiæ*, to which the New

Zealand bird is also clearly referable. The generic title adopted by Mr. Gould (*Phalacrocorax* of Brisson) appears to me more satisfactory than *Graculus*, about which there seems to be no finality. In Mr. G. R. Gray's first list (*App. to Dieff, N.Z.*, Vol. ii., p. 201) it was written *Graucalus*, and in his *Zoology of the Erebus and Terror*, Birds, p. 20, it was changed to *Graculus*, and in his latest list (*Ibis*, 1862) it became *Graculus*, a term originally applied specifically by Linnæus to the green cormorant of Europe, *Pelecanus graculus* (*Syst. Nat.*, Vol. i., p. 217).

Note to Art. II.—Buller's List of New Zealand Lizards.

Add, — 12 b. *Naultinus lineatus*, sp. n., Gray. *Ann. and Mag. Nat. Hist.*, 1869, Vol. iii., p. 243.

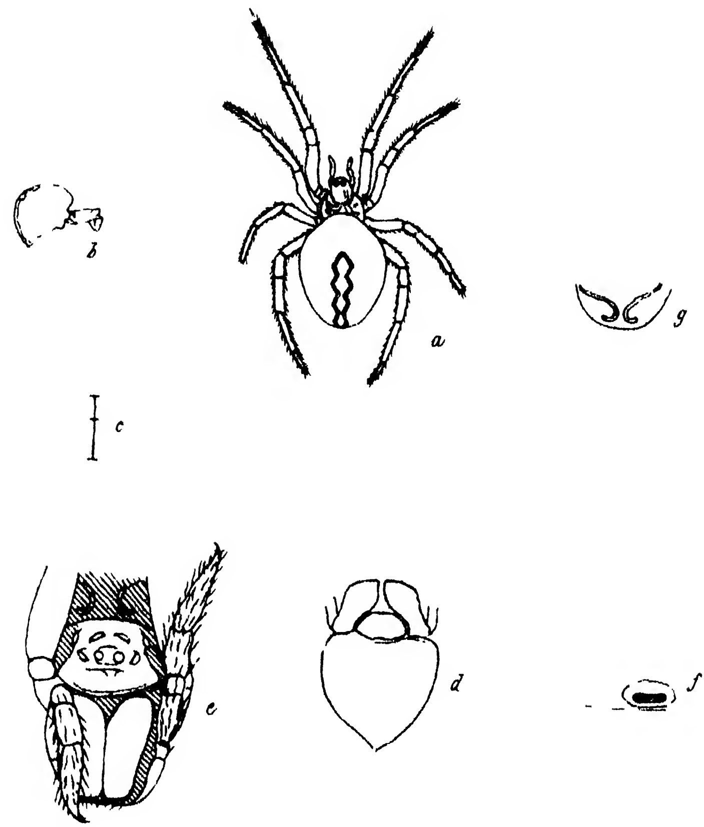
Art. X.—*On* Latrodectus (*Katipo*), *the Poisonous Spider of New Zealand.* By Ll. Powell, M.R.C.S.St.A.

(With Illustrations.)

[*Read before the Philosophical Institute of Canterbury, May* 4, 1870.]

A communication was read before the Auckland Institute in October last, by F. W. Wright, Esq., L.M.P., on a case which came under his observation of the ill effects produced by the venomous bite of a spider, known to the natives under the name of the *Katipo*; he also related two or three cases recorded by other observers. Both in the local effect and the extreme prostration of vital power, there was great similarity to the injuries inflicted by venomous snakes, and in one case death is said to have followed after a considerable interval. The injurious effects of the bite are well known to the natives, and, according to Mr. Wright, they describe two kinds of Katipo, one black, the other black with red markings; the noxious properties of the former seem doubtful, but all agree that the red-spotted spider is highly poisonous.

Dr. Hochstetter says,—"As we were about to camp for dinner, we were cautioned by the natives against a small black spider with a stripe on its back, which they call Katipo. The spider is said to exist only here and about Otaki, on Cook's Strait, on the grass growing upon the sand-hills, and its bite to be so poisonous, that with sickly persons it has even caused speedy death. * * Ralph, in the *Journ. Proc. Lin. Soc.*, describes it as a real spider, of a very different appearance at different periods of its age; when full-grown it is black, with an orange-red stripe on its back. Ralph mentions also that he had put the spider together with a mouse, and that the latter died after eighteen



LATRODACTUS (Katipo ?)

a. Adult Female × 2½ diam b. Profile c. Real size

d. Labium, Maxillæ, and Sternum

e. Front view of Cephalothorax showing arrangement of eyes, falces, maxillæ, &c. f. Vulva

g. Anterior aspect of abdomen.

L. C. Powell del. J. B. lith. Printed at the Gen. Chr. Lith. Press.

hours in consequence of the spider bite."—(*Hochstetter's New Zealand*, p. 440.) I am sorry that I have not been able to obtain the volume of the Linnean Society's Transactions, containing Dr. Ralph's communication.

These spiders are tolerably numerous in the North, but rare in this Island. Dr. Haast, however, informs me that, according to the Maoris, Katipos have lately made their appearance in the sand-hills near Rangiora. On Friday last I received from Mr. Nottidge a spider which he found beneath a stone in the Maori Pa at Woodend, and which corresponded to the description of the Katipo, and on comparing it with a dried specimen given to Mr. Fereday as a Katipo, I found it to be of the same species. I have had no opportunity of testing its venomous properties, but I shall show in the sequel that there is very good reason for believing that it is truly poisonous. I am not aware that it has been scientifically described, or that it has received any specific name.

The following is a description of its affinities and characteristics:—

Fam.—THERIDIIDÆ. Gen.—LATRODECTUS.

Provisional specific appellation.—*Latrodectus Katipo.*

Adult female.—Length of body ⅓-inch. Cephalothorax, broad posteriorly, constricted and somewhat produced anteriorly, flattened; caput, elevated and well defined, normal grooves fairly indicated; a transverse depression behind the caput; colour, a glossy black. Eyes, eight in number, tolerably equal in size, the anterior middle pair being slightly the smallest, arranged in two transverse rows of four each towards the anterior aspect of the elevated caput, very slightly curved forwards; eyes of anterior row distributed at equal distances, middle pair situated on a common projection directed anteriorly; external eyes situated on slight eminences directed downwards and outwards, posterior row more widely distributed than anterior row, at equal distances; middle pair sessile directed upwards and slightly outwards; external eyes on eminences directed outwards and slightly backwards; clypeus as deep as the width of the anterior row, divided by a transverse sulcus a little below the anterior eyes; lower division of clypeus tumid with a slight vertical median depression; the eyes shine with a pearly lustre, so that the posterior middle pair are plainly visible without magnification. Legs tolerably robust, of moderate length, the first pair are the longest, then the fourth, the third pair are the shortest but do not differ greatly from the second pair in length; colour black, the tarsus and metatarsus reddish, clothed with fine blackish hairs, especially the two posterior pairs; three claws, two of them pectinated. Palpi of moderate length, black and hairy like the legs, terminated by a single pectinated claw. Labium considerably broader than high, the free border forming nearly a continuous curve, slightly flattened anteriorly. Maxillæ moderately long, much inclined on the lip, convex transversely, inner

extremity pointed, inner border slightly convex above lip, concave towards lip; superior border truncated, forming an obtuse angle with external border, which slopes away to the insertion of the palpus. Maxillæ and labium brownish-black, sparsely clothed with fine brownish hairs. Sternum heart-shaped; black, and somewhat hairy, especially towards the border. Vulva, a simple transverse opening without appendages; palish-brown, situated on the summit of a mammillary protuberance. Falces vertical, rather small, terminating below at the upper surface of the maxillæ, which project slightly beyond them. Abdomen sub-globular, very convex above, overhanging the base of the cephalothorax, anus and spinnerets not visible from above, upper surface a rich glossy blue-black, thinly clothed with black hairs, anteriorly are two interrupted yellow lines, formed like notes of interrogation with the convexities opposed, these are not visible from above; from the mid-point of the upper surface to the anus runs a bright scarlet band with vandyked borders; it may be described as consisting of four confluent lozenge-shaped spots; there was a slight indication of a yellowish bordering to the stripe. Under surface of abdomen black, with an obscure red patch on either side of the vulva; a similar patch anteriorly to the spinnerets.

I have been thus particular in my description, because, amongst spiders, individuals of different species so closely resemble one another, that a very minute description is necessary to enable an observer to decide the species with certainty.

Now, with regard to the venomous attributes of this spider. It belongs to a genus which contains several species also reputed poisonous; thus Walckenaër says of the *Latrodectus malmignatus*, an allied species, common in Sardinia, Corsica, and parts of Italy,—"This species is certainly poisonous; its bite causes, they say in man, pain, lethargy, and sometimes fever. M. Liugi Totti, Physician to the Hospital of the Madeline at Volterra, in a long memoir which he has sent us, confirms all that has been written concerning the effects of this spider by Boccone, Heyder, Rossi and others; however, its mandibles are not very strong and it is not large (about half an inch in length)." Mr Abbot, (who was ignorant of what had been written in Europe concerning the *Latrodectus*) in his *Georgian Spiders*, says,—"Of three species (of *Latrodectus*) which he has figured, that their bite in America is undoubtedly venomous." (*Walckenaër Histoire des Insectes Apteres*, pp. 643, 644.) The fact is extremely interesting, that in a genus of spiders containing comparatively a very small number of species, these species are so widely distributed over the world as to be found in Europe, America, and New Zealand, all being highly noxious, and all, with one or two doubtful exceptions, being black with red markings; for colour is of all characteristics the most variable, and most particularly so in spiders.

So much has been fabled concerning the bite of the tarantula, a spider of

the genus *Lycosa*, and it is so well known that the bite of the great majority of spiders is innocuous, that one feels inclined to doubt whether all these accounts of poisonous spiders are not greatly exaggerated; still, considering the independent sources of our knowledge, we cannot but conclude that many members of the genus *Latrodectus* are highly venomous.

In conclusion I may say, that it is very desirable that all cases of bites of supposed poisonous spiders should be carefully recorded, but only by eye witnesses. I shall be very glad to receive specimens to experiment with.

ART. XI. — *On the Birds of New Zealand.* By T. H. POTTS.

(PART II.)*

(With Illustrations.)

[*Read before the Wellington Philosophical Society, June 25, September 17, and October 22; and before the Philosophical Institute of Canterbury, September 7, 1870.*]

THE following additional Notes on some of our Birds are offered with a full sense of their want of completeness, which will be felt by those whose habits lead them to gaze on the face of nature. As a record of facts, they have been written at different times and places, for the most part amongst the birds themselves when the leisure hour permitted, in the cultivated garden, beneath the deep shadows of the leafy gully, on the wide expanse of the brown tussock-clad plain, by the rocky coast, or in the gloomy alpine valley.

It is yet possible to reach some secluded spots where the hanging branches of the virgin forests exhibit lovely forms and hues of glorious foliage in all their pristine beauty, still unscathed by fire or bushman's axe; where birds still flutter and carol through revolving seasons of a golden age; where the murderous guns, the stealthy cat, are alike unknown; where the bold confident curiosity of the birds surprises the human trespasser, and teaches him, in the plainest language, the story of the changes effected by the savage barbarity of man.

It is felt that some of the papers may be thought long and tedious; but in explanation, it may be stated that I have since last year met with Gray's *List of the Birds of New Zealand and the Adjacent Islands*, and Mr. Gould's *Handbook to the Birds of Australia*, and thought it desirable to comply as far as possible with a wish expressed in the latter work, and make the notes on the genera *Athene*, *Nestor*, etc., rather full. In the illustrations it will be observed that the majority of the nests figured are those of indigenous species; such a selection, it was thought, would be interesting.

* For Part I., see *Trans. N. Z. Inst.*, Vol. II., Art. VIII., p. 40.

LIST OF BIRDS DESCRIBED IN THIS PAPER.

[The species are numbered in conformity with the list given with the author's former paper,—*Trans. N. Z. Institute*, Vol. ii., p. 49.]

No.

1. Hiericidea (Falco) Novæ Zelandiæ, *Gml.*
3. Athene Novæ Zelandiæ, *Gml.*
4. ,, albifacies, *Gray*, (ejulans, *Potts*,) (Strix Haastii, *Buller.*)
6. Strix ? (parvissima, *Potts*,) (delicatula, *Gould.*)
7. Halcyon vagans, *Gray.*

B. 7. ,, cinnamominus, *Swain.*

11. Anthornis melanura, *Sparrm.*
15. Pogonornis cincta, *Dubus.*

B. 19. Orthonyx (Mohoua) albicillus, *Gml.*
[No. 27 of former list.]

24. Gerygone flaviventris, *Gray.*
29. Petroica macrocephala, *Gml.*
33. ,, albifrons, *Gml.*
34. Anthus Novæ Zelandiæ, *Gml.*
35. Zosterops lateralis, *Lath.*
37. Rhipidura flabellifera, *Gml.*
51. Nestor meridionalis, *Gml.*
53. ,, notabilis, *Gould.*
56. Stringops (Strigops) habroptilus, *Gray.*
57. Eudynamis Tahitiensis, *Gml.*
60. Coturnix Novæ Zelandiæ, *Quoy.*

B. 65. Anarhynchus frontalis, *Quoy.*

74. Ardea sacra, *Gml.*

B. 75. Ardetta pusilla, *Gould*, (Botaurus minutus, *Haast.*)

87. Ocydromus australis, *Sparrm.*
91. Porphyrio melanotus, *Temm.*
95. Spatula variegata, *Gould.*
98. Hymenolaimus malacorhynchus, *Gml.*
99. Podiceps rufipectus, *Gray.*

B. 131. Sterna (alba, sp. nov. ? *Potts.*)

134. Phalacrocorax (Graculus) carbo, *Linn.*

No. 1.—Falco Novæ Zelandiæ, Gml.

(See also Vol. ii., p. 51.)

As it is probable that further information concerning the genus *Falco* may form the subject of a future paper, it has been thought preferable to reserve

EYRIE or nesting place of FALCO NOVÆ ZELANDIÆ
See Vol II Page 51

Printed at the Gen. Gov. Lith. Press

notes which have been prepared on the question as to whether we possess more than one species of *Falco*; and I will for the present only refer to Plate IX., which represents a nesting place on the edge of a wooded gully, intersecting one of the spurs of Rocky Hill, Malvern Hills, from whence three eggs were taken in the month of November.

No. 3.—Athene Novæ Zelandiæ.

Ruru, rurupeho.

More-pork.

The small number of species of nocturnal *Accipitres* that are at present known to exist in this country is in correspondence with the marked absence of variety in the species of diurnal *Raptores* in our bird system; yet, that it should do so appears unaccountable. In the first place must be noted the entire absence of the *Caprimulgidæ*, a family which, in many lands, in the chase of their insect prey compete with several of those species of *Strigidæ*, which are crepuscular, or nocturnal, in their habits. The ceaseless persecution which the falcons and harriers have sustained at the hands of the unreflective European settler must have ensured a very abundant supply of food to the owls; some of the smaller mammalia have increased enormously; mice, young rabbits, rats, and insects, form no inconsiderable items in the food supply of hawks in many places. It was therefore not unreasonable to suppose that a considerable increase would have been perceptible in the number of these vermin killers, but the reverse is the case. In most districts with which we are acquainted, the More-pork has become very much scarcer during the last few years; the increase in the number of prowling wild cats, taking up their abode in gullies and bushes, has, doubtless, tended to this result; in such places they could steal upon the owl at its "secure hour," when dozing off the fatigue of midnight rambles; but the prime cause of its increasing scarceness is traceable to the alarming rapidity with which so many of the forests in Southern districts have been damaged or destroyed; the effect of this change in the aspect of the country on a bird so arboreal as *Athene Novæ Zelandiæ* can be readily appreciated, delighting, as it does, in the shelter of the densest shade, wherein to pass its many hours of inactivity and repose.

Although the living figure of our owl may be unknown to most persons, from the nature of its habits, yet few, perhaps very few, of the older settlers are unacquainted with the human-like cry of the More-pork. The distinctness of this call has conferred the name by which this useful bird is generally known throughout every part of the country, and for a similar reason the same name has been bestowed on a *Podargus* in Australia. As soon as night begins to spread its darkening shadows over our brief twilight, this active creature sets out on its hunting excursions, roaming over field and gully with soft,

noiseless flight, one of the advantages it owes to its flocculent plumage; its cry of "morepork, morepork," is repeated at frequent intervals, sometimes with the utmost rapidity of utterance; its course may thus be traced as it emerges from the wooded gullies in the hills, the sound re-echoed in the stilly night by the opposing heights.

The power of voice which has been conferred on the *Strigidæ* is one of the most remarkable features in their economy, this power is the more striking from being used when nature is hushed into repose; when the owl utters its startling sounds, whilst borne along on noiseless wing, the effect produced on its terrified prey would disclose its presence as surely as though discovered by a gleam of light, as it dashes frantically hither and thither in its wild efforts to escape, unnerved by the war-whoop of its enemy, whose soft, loose plumage enables it to follow the course of the quarry, not only silently but swiftly; far differently indeed from the impetuous rush of the falcon, swooping on its victim in mid-air, yet, perhaps, not the less sure. The course of its terrified prey would probably be tortuous, as it fled bewildered in the darkness, followed in its windings by the glowing orbs of its untiring, relentless pursuer, which could by raising or ruffling its downy feathers offer a resistance to the air that would instantly act as a break in checking such undue speed as might render the bird liable to overshoot its game.

The owl is far from being a timid bird, notwithstanding its love for gloomy shades; often in the summer moonlight have we watched it on a rail or fence close to the sea-beach, probably on the alert to seize various insects that frequented the thickets of *Myoporum*, *Olearia*, *Leptospermum*, etc.; oftener still have we observed it busy on a mousing expedition, at the barn and farm buildings. Allowing a very close approach, within a couple of yards, it was to be seen perched on a post or gate, motionless, all but a slight movement of the head, suddenly disappearing for a few moments, probably long enough to catch and entomb a mouse; its movements occasioned no sound that could be detected by an attentive ear. Now and then a short note was emitted, probably to scare its game into motion, which sounded like a grating scream of "tchoo, tchoo."

Of its breeding habits we know but little. About three years since, two young birds were found in an old decayed tree in the bush by Cooper's Knobs, at the head of Lyttelton Harbour. An old breeding-place in a hollow rock in the bush at Ohinitahi, furnished a quantity of castings; from an examination of these, which contained remains of mice, *Cicadæ*, *Coleopteræ*, etc., it appeared probable that spiders, taken in their webs, formed some portion of their food.

Superstitious fancies, and even dread of the owl, has at times prevailed almost everywhere. "The oule eke, that of deth the bode ybringeth," sang the father of English poetry, and we learn from Colenso that some of the Maori tribes disliked the owl, which they persecuted and killed. Should a

remnant survive the hard times of the first rough settlement of the country, there is little doubt its usefulness will be properly recognised and appreciated as a farmers' friend.

We have known a More-pork remain for several weeks in a deep shady gully close to the house; if disturbed during the daytime it appeared dazed, its flight irregular and awkward, the bird seemingly anxious only for concealment in the grateful shelter of the nearest dusky patch of shade it could reach. It is not unfrequently found in barns or sheds, sleeping on the roof; if molested, using its beak freely on the hands of its captor. A friend of ours captured one by hand whilst it was sitting on a fence in the twilight hour.

No. 4.—Athene albifacies, Gray, (ejulans, Potts.)
Sceloglaux albifacies, Gould.
Wekau.
Laughing Jackass.

However much changes in nomenclature are to be deprecated, the specific name which has been hitherto assigned to the large owl, the Wekau of the Maoris, appears so inappropriate, failing, as it does, to convey anything like a correct impression of the bird's appearance, that we are tempted to offer the above as an amendment, one that is intended to express the leading characteristic by which it is best known in the localities which it frequents.

We have enjoyed opportunities of observing living examples, of examining freshly killed as well as finely-preserved specimens, but have not yet met with a white-faced bird; on the other hand, its loud cry, made up of a series of dismal shrieks frequently repeated, waking the tired sleeper with almost a shudder, at once distinguishes the "Laughing Jackass" as one of the peculiarities of the mountain districts. Will these reasons be held to be of sufficient weight to justify the proposed alteration of its specific title? Why it should share with one of our petrels and the great *Dacelo* of Australia the trivial name of "laughing jackass" we know not; if its cry resembles laughter at all, it is the uncontrollable outburst, the convulsive shout of insanity; we have never been able to trace the faintest approach to mirthful sound in the unearthly yells of this once mysterious night bird—mysterious, because for years unsuccessful attempts had been made to secure a specimen of this dismal visitor, whose fitful presence at eventide was scarcely observed before its form was lost to view in the deepening gloom of approaching night. A sea-bird, one of the *Procellaridæ*, *P. Cookii*, gives utterance to a very mild version of the Wekau's call, especially before rain it is averred, but the petrel's note is wanting in the intensity of the dreadfully doleful shrieks to which the owl gives utterance. (See Captain Hutton's "Notes on the Birds of the Little Barrier Island," *Trans.*, Vol. i., p. 162.) Mr. W. Newton lately, at the Levels Station, near Timaru, secured a specimen of the Laughing Jackass whilst engaged

in the very act of making night hideous, so that all doubt has been removed as to the bird from which this startling cry proceeds ; this night-call was referred to in "Notes on the Birds of New Zealand," *Trans.*, Vol. ii., pp. 45, 46.

In 1854, at Rockwood, in the Malvern Hills, we first became acquainted with the Wekau ; it had been captured in a drain or ditch, and lived in a half-tamed state for some time, beneath the house, till unfortunately destroyed by a visitor's dog. At the present time a very fine owl may be seen at the Christchurch Acclimatization Gardens, where it has lived in confinement about two years ; we believe it was obtained from the Cass River.

In its customary position, when at rest, the great length of the tarsi are concealed by the plumage of the breast, the head feathers are so raised as to increase the apparent size of the head, this lessens very much the hawk-like appearance which the prominent beak usually gives to preserved skins of this bird ; the large brown eyes are very striking, but so sensitive that the owl apparently suffers great discomfort when forced into daylight ; the irides then become scarcely discernable ; the tarsi densely feathered, on examination appear remarkable for their depth no less than their length, the skin feeling loose or free to the touch ; in dried skins this of course could not be observed ; much of the peculiar character of the nostrils also is lost in preserved skins ; the toes dull flesh colour, sparsely covered with hairs ; the claws white, much curved, and sharp. The entire plumage is of warmer shades of brown than most of the specimens which we have seen, but has no claim to a white face ; the outer edge of the facial disk, where it covers the auditory conch, is whitish grizzle ; the nostrils appear raised or swollen. The Curator of the Gardens states that he has heard the cry uttered but rarely, it was of a most dismal character ; it is fed on mice, rats, and birds ; it refuses to eat any kind of meat that may be thrown to it ; its sight is thought to be affected.

Some years since, we saw a fine bird which had been caught, on the preceding night by a bushman, on the Upper Rangitata Flat ; the intelligent captor signalized his good fortune by chopping off the head of his victim with the ever-ready axe. The look of satisfied triumph, as the bird was pointed at, we never saw equalled, except perhaps on one occasion, when a friend, fresh from town, entered the house with the mangled remains of a tame kaka, which he had blown almost to pieces in a kowhai tree, from whence poor Bess had unfortunately studied the stranger's face too closely. A Wekau entered a shepherd's whare at the foot of Mount Hutt, and remained for several days, perching in the roof ; on one occasion it seized a mouse which a cat had just brought in. Another visitor of this species remained in a station on the Rangitata for some weeks. Last year, a fine light-coloured specimen was obtained at the Point Station, Malvern Hills ; when killed it was perched on the rail fence, not many yards distant from the house. Of the examples in the Canterbury Museum, one was procured from the Kakahu Bush, near

Arowhenua; another, killed at the Levels Station, as before stated, was presented to the Museum by Mr. Donald Maclean.

Mr. E. Dobson states that the Waimatemate Maoris describe this owl as living in holes in the rocks; they call it Kakaha; they say it is as large as a pigeon (*Carpophaga Novæ Zelandiæ*), with a white breast, that it has a "wide mouth bill," comes out at night only, and flies without noise.

Dr. Haast says that the owl provisionally named by Mr. Buller, *Strix Haastii*, is according to his opinion, *Athene egulans*; it was captured by his dog amongst the rocky precipices in a creek near the Lindis Pass, in the Province of Otago; he also states that one night, in 1861, when camping on the Upper Rangitata, under Mt. Potts, that judging from the noise there must have been many of these birds flying about, that he and his party were kept awake several hours by their shrieking clamour.

In May, 1857, while living in a tent on the Upper Ashburton, we were constantly disturbed at night by their doleful yells amongst the rocky mountain gullies.

Some of the finest specimens known are preserved in the Museum at Dunedin. (See "No. 4, *Athene* (*Sceloglaux*) *albifacies*.—'Wekau' or 'Whekau' of the Natives (specimen belonging to Mr. Clapcott)," in Dr. Hector's "Birds of Otago." *Jurors' Reports*, 1865.)*

When disturbed on the ground, it has burst forth into its weird-like cry immediately after taking wing. Its robust form, thickly clothed with soft feathers, is admirably adapted for encountering the severities of climate to which it must be frequently exposed whilst scouring its wild hunting grounds. Far less arboreal than its smaller congener, it roams over the bleakest tracts of country, in many districts where bush of any extent is rarely to be met with, finding shelter amongst the numerous crevices in the rocks of rugged mountain gullies; strictly nocturnal in its habits, in pursuit of its prey, it must brave the icy blast of the alpine snow storm at the lowest temperature. The severity of the climate in these elevated regions would scarcely be credited by those who have only known the mildness of the coast line. As may be inferred, the real home of this hardy raptorial is amongst the fastnesses of the Southern Alps, from whence it makes casual excursions, by the numerous river beds, to the lower lying grounds, those occasional visits extending as far as the plains. Although well known from its cry, not many specimens have been obtained, as fortunately for its preservation it is seen only at eventide or night. From the enormous increase in the numbers of the introduced rodents, the day is probably not far distant when the farmer will be as anxious for the preservation of the few groups of vermin killers as for the protection of game birds.

* Mr. Clapcott's specimen was obtained at Popotunoa, and others have been seen near Waikouaiti, Shag Valley, and other localities near the coast.—Ed.

The introduction of *Strix flammea* to our widely spread agricultural districts would, it is believed, prove a boon of great value; many other species of perhaps equal worth might be imported through the aid of the flourishing acclimatization societies; much corn might, by this means, be saved from the damage occasioned by the depredations of mice, etc. The risks which the newly-imported bird has to encounter should not be forgotten; it has truly to pass through the *ordeal of fire;* perhaps the intense sporting, not to say destructive, instinct which is occasionally exhibited by certain of our fellow-settlers, may be the shadowy tradition of that once exclusive recreation of the great ones of the earth, that "gift of the gods," that has been styled in earlier days, "Studium nobilium, communiter venanter, quòd sibi solis licere contendunt."

It is gratifying to reflect on our march of progress and freedom even in such a small matter as this fowling; not that the result has been invariably a subject for congratulation. One of the earliest imported Tasmanian magpies was killed in Lyttelton; of the pair of "silver swans" that graced the Avon, one was bravely encountered and slain near Riccarton; and it was announced within the last few days, that the first partridge which had visited the Rakaia paid with its life for the privilege of gazing on the mighty "Sun stealer." *

The large owl has rarely reached Europe, as, according to Gould's *Handbook to the Birds of Australia*, Vol. ii., Appendix, only two specimens appear to be known there, one of which is in the British Museum. As standard works of reference here are as rare as "pearls of great price," possibly it may be considered convenient to give the two descriptions of this bird from the pen of Mr. G. R. Gray, *Voy. of Ereb. and Terr.*, Birds, and also that by Mr. Gould in his *Handbook.*

Mr. Gray's description of the specimen in the British Museum is as follows:—Dark brown, each feather margined on the sides at the tip with fulvous; quills and tertials brown, spotted with obsolete bands; tail dark brown, with five bands, and the tip of each feather rufous white; forehead and cheeks white, with the shaft of each feather black; tarsi covered with white feathers slightly tinged with rufous; toes covered with scattered white hairs. Length 1 foot 3½ inches; bill from gape 1 inch 4 lines; wings 11 inches; tarsi 2 inches 5 lines. This specimen was obtained at Waikouaiti.

Mr. Gould does not say distinctly whether the following description he

* Said to be so called by the Maoris of Tamatu, because the sun sets behind the mountains that shut in the Gorge of the Rakaia. Our knowledge of the native tongue is so limited that we are unable to declare "Sun stealer" as the correct interpretation of "Rakaia." The idea is not without poetical feeling; the sun, which meant everything to the Maoris of earlier days, and kept away the spirits of darkness, being lost behind the mountains of the Rakaia Gorge, it was not without reason the great river was stigmatized as the Sun stealer.

gives is from the same specimen :—Plumage of the upper surface, chocolate brown, each feather margined with fulvous; some of the scapularies with a lengthened mark of dull white within the margin, and others on the edge; primaries spotted along the outer margin with buffy-white; secondaries and tertiaries crossed by indistinct or interrupted bars of buffy-white, assuming on those near the body the form of spots; spurious wing very dark brown; tail brown, crossed by five narrow irregular bars of buffy-white and tipped with fulvous; facial disk pale sandy-brown, except on the forehead, throat, and ear coverts, which are whitish, each feather with a streak of brownish black down the centre; feathers of the under surface deep fulvous, with a broad mark of deep brown down the centre of each, the former tint increasing on the lower part of the abdomen and thighs, when it again gradually fades into dull white on the lower part of the tarsi; toes sickly green, thinly beset with hair-like feathers; cere much developed and of a lead colour; bill bluish horn colour at the base, passing into yellowish horn colour at the tip, the under mandible yellow.

After examining the specimens (four), which are now accessible for the purpose of this paper, the description of the bird killed at the Point Station is given; it is the lightest-coloured example, and, as will be seen, it bears a close resemblance to those descriptions already presented. Upper surface brown, feathers margined with fulvous, some with a lengthened mark of dull white within the margin; primaries brown, spotted along the outer web with buffy-white, inner web indistinctly barred with lighter brown, these marks becoming dull white towards the basal part of the quill; secondaries and tertiaries brown, crossed by interrupted bars of buffy-white, occasionally marked with spots of the same colour almost oval in shape; tail brown, crossed by five irregular bars of buffy-white tipped with fulvous, mottled or clouded with pale brown; facial disk palish brown; forehead and throat grizzle-grey; ear coverts almost white, with long lanceolate streak down the centre of each feather; under surface rich fulvous, with a broad mark of dark brown down the centre of each feather; the apical portions of the light flocculent feathers of the lower part of the abdomen show fulvous; on examination, two-thirds of the basal portion of each feather is slaty-black; thighs fulvous; tarsi pale fulvous; toes yellowish flesh, with scattered hair-like feathers; cere much developed, reaching below the nostrils, which are raised; bill curved from the base, white clouded with horn colour. Measuring from gape to extremity of upper mandible 1 inch 4 lines; upper mandible extends beyond the lower 2 lines; wings slightly concave, nearly 13 inches, fourth quill feather longest; legs long; tarsi 2 inches 8 lines; total length 17 inches 3 lines.

A description of a specimen in the Dunedin Museum is as follows:—Length from top of head to end of tail $16\frac{3}{8}$ inches; wing from tip to flexure point $10\frac{1}{4}$ inches; tarsus $3\frac{3}{8}$ inches; hind toe and claw $\frac{7}{8}$ inch; middle toe and

claw 1½ inch; foot covered with thin bristly hairs, feathered to foot. The feathers in disc which encircles the eyes, are of a dark grey colour, of a thin bristly appearance before the ears, but behind the ears there is a collar of soft white feathers from the top of ears under the chin, forming the outer edge of disc round the eyes; feathers from beak, over top of head to back, dark brown centre with bright buff margins; coverlets of wings dull brown with buff flakes; primaries of wings and tail dull brown with buff or dirty white bar across; breast brown centre with broad buff margins, the margins getting lighter and broader as they go down the body to abdomen, which is yellowish; legs light mealy colour, buff and brown. For the above we are indebted to Mr. Purdie, Curator of the Dunedin Museum.

However tedious these descriptions may appear, they are presented in order that we may arrive at the true history of the bird; there can be no doubt as to the specific identity of the owls described, there may be slight variances in shades of colour, but certainly not more than would be observed in a very small party of human beings that might be assembled from any English village or petty town. Here, doubts are entertained by some, not only whether the large owl is the bird which has been named *A. albifacies*, but also, whether it is other than a large specimen of the more-pork, *Athene Novæ Zelandiæ*; the former of these doubts may possibly be removed by a perusal of the foregoing descriptions and a careful comparison with the specimens that are accessible, whilst it appears curious that the latter opinion should be seriously entertained, when it is considered that in order to sustain it a bird must exhibit a total change in habits, voice, to a certain extent locality, and an increase in size to at least one-half.

No. 6.—Strix parvissima, Ellman. (*Zool.*, 1861.) Little Owl.

Amongst the desiderata of our public collections the Little Owl has for some time held a place; many doubt its existence, few have seen it, still fewer have preserved any note or observation concerning it. From the information that has been gleaned about this rare bird, it would appear that its habitat must be the bushes about the Rangitata River.

One correspondent saw it on the bank of a creek at no great distance from Mount Peel Forest, it was between the roots of a large tree; observation was drawn to it by the proceedings of several tuis, who were persecuting it to the best of their ability; it was whilst its attention was engaged by these noisy assailants that the bird was secured. It was about the size of a kingfisher, and its captor felt quite certain of its being an adult specimen; it was carried home to be shown as a curiosity, and was afterwards liberated. Unlike the more-pork, when captured it was exceedingly gentle.

Another specimen was procured by a gentleman in one of the bushes far

above the Rangitata Gorge; on being observed on a branch of a tree, it was knocked down and caught during its fall; there was fur on its beak, as though it had not long before devoured a mouse; this bird was also set at liberty.

Two other instances of its occurrence have been communicated, but without further information. It may be mentioned that one of these was again on the Rangitata.

At Shepherd Bush Station, on the Rangitata, opposite Peel Forest, a specimen was observed in the house, greatly resembling *A. Novæ Zelandiæ*, except in size, which was about that of a kingfisher; it was most gentle in its habits, remaining quiet during the daytime and sallied forth in the evening, regaining its perch by entering through a broken window. This pretty little visitor thus frequented the house for about a fortnight; it should be added that the house stands close to a small bush composed chiefly of *Leptospermum*, *Griselinia*, etc., of which there are many aged specimens.

From these notices it may be safely inferred that the Little Owl is arboreal in its habits, and possibly not so strictly nocturnal as its better known congeners; whether it is to be considered identical with either of the species referred to by Dr. Finsch is, of course, at present unknown; it is certain it is not a tufted species, or such a remarkable form would have been noticed.

No. 7.—Halcyon vagans, Gray.

(See also Vol. ii., p. 52.)

Towards autumn, these, our intimate friends, who have been absent during the summer on urgent family affairs, make their welcome re-appearance in the gardens; they may now be seen in numbers; early in the month of March it would not be difficult to count a dozen of them at one time on the posts and espalier rails. When not engaged in making those well-known rapid darts, their habit is to remain perfectly still, and, for the most part, silent; they indulge in no joyous fluttering amongst trees and shrubs, they pour forth no melodious song, for their various cries are most unmusical and harsh. Our species shares that sedate gravity of the family which has long been remarked, even by such writers as one of the butterfly poets of the "Merrie Monarch's" Court, who wrote,—

> "That with such *Halcyon calmness* fix our soules
> In steadfast peace, as no affright controules."

To us this gravity seems to verge on melancholy, and Dryden's expression, when he calls them "the mournful race," appears apt enough. Burton's wonderful book bears on its quaint frontispiece the figure of the kingfisher occupying a place amongst the several emblems of jealous melancholy, which he thus describes,—

> "To th' left, a landskip of jealousie
> Presents itself unto thine eye—
> A Kingfisher ——"

When perched on its commanding stand-point, from the tarsi being entirely concealed by the over-lapping breast feathers, its figure is greatly puffed out; its contour assumes a rotundity quite aldermanic. Its omnivorous propensities and monstrous appetite duly considered, perhaps the resemblance might be carried still further than a fancied likeness, when apparently suffering the pangs of repletion. This ravenous appetite, useful as it proves in many respects, we fear often leads its possessor into trouble. The Kingfisher is not afraid of man, does not shun the cultivated homestead; it finds the unplumed biped profitable, as in the sweat of his brow and by the toil of his strong hands, fields are ploughed and gardens dug where the root-matted earth has never been exposed before, and a rich feast is provided for the robust-beaked bird, into whose craving maw the larvæ of many destructive insects descend, to the great advantage of the cultivator. Its labours even then are not always gratefully appreciated; its gaudy plumage often ensures tribulation, perhaps death, and then in a glass case, surrounded by brilliant butterflies, seaweed, moss, shells, and such like *appropriate* accessories, it undergoes a species of apotheosis, from its place on high, glaring fixedly at the world beneath.

On looking at its favourite perches about the beach (it is a creature of habit, and makes use of the same resting place again and again), remains of *Crustaceæ* may be found, on posts, trees, rocks, thwarts or gunwales of boats; amongst the *disjecta membra* we have seen, yet rarely, the remains of fish. It does not wholly despise bees, thereby proving a distant cousinship with the *Alcyonic Merops;* that it devours "mice and such small deer" we know. Sometimes grave charges are preferred against our omnivorous friend, as may be gathered from the report of the Auckland Acclimatization Society for 1868-69:—"The Curator states that the *Kingfisher* has proved very troublesome in destroying birds, having killed a Californian quail and attacked another bird, which, however, made its escape." In Otago they have been accused of purloining the speckled trout; in Christchurch Gardens, the shallow artificial streams, where the newly-hatched trout are nursed, receive the protection of wire netting, thus the young fish are kept safe, both from the fishing spear of this bird and the enterprising beak of the large shag. The Curator found by examination that out of about a dozen Kingfishers that had been destroyed, not one contained remains of small birds.

On the whole, there is no doubt that it is far better policy for the settler to protect this useful bird, as an insect destroyer, than to persecute it for an occasional attack on small birds or young fish; with anything like good management, loss to any extent from this cause might be avoided.

When its prey is captured, it is very rarely eaten on the ground; the shortness of the tarsi (only about 6 lines in length), and the comparatively feeble feet are not adapted for locomotion, either by walking or climbing. Its keen eyesight is remarkable; amongst grass it can detect an insect,

although yards distant from its stand-point; often it may be noticed perched on a small fragment of rock by the mud-flats of the harbour, certainly at a less elevation than one foot from the surrounding level surface, at several yards distance it has seen some small *Crustaceæ* moving, in an instant the dash is made, the prey captured, and, very often, the *same stone* occupied. This sudden feat is performed repeatedly within half an hour; it shows how admirably the structure of the bird must be adapted for bearing the very severe strain to which certain parts of its frame must be exposed during this trying evolution; in commencing its swift dart it may derive some assistance from its perch by using it as a fulcrum, with its long spear-like bill carried straight, it shoots to its mark, cleaving the air like a winged wedge; nor is there any perceptible motion of the wings till the prey is secured; with a sudden twist, a few rapid strokes of the wing, and the return is accomplished. Although it appears so difficult to effect, yet in the great majority of cases its return is made by a very sharp curve, rather than by a gentle sweep, extending its flight to some more convenient perch.

Its power of vision may be judged of by the following note, entered at the time:—May 10.—Noticed a Kingfisher flying higher than usual, almost in a straight line, apparently making for a dead tree across our little bay; when out over a hundred yards, it suddenly and rapidly turned in its course, retracing its line to the starting point (a large *Eucalyptus*); when perched, observed it busy with a large insect which it had secured. This feat appeared rather that of a *Merops* than that of the bird we call a Kingfisher.

Far inland, the bird is comparatively rare; we have not observed its breeding-place at any considerable distance from the coast line. Its song of courtship is a harsh, scraping, clashing sound, most unmusical.

It has been mentioned before that it is a creature of habit; this is borne out by observing its favourite roosting places; the same trees are occupied, although the birds have been repeatedly disturbed at night by the glare of a lanthorn; the soil below is whitened with the liquid fæces; castings also abound there. The hillside bush is not unfrequently sought for a breeding place.

No. B. 7.—Halcyon cinnamominus, Swain.

We have never enjoyed the opportunity of observing a specimen of this member of the *Alcedinidæ*, but in the interests of ornithology feel bound to mention communications received from two friends of the writer, living far apart, who are in the constant habit of observing, noting and collecting specimens of natural history.

Mr. E.,—noticed a brown or dun-coloured bird at Akaroa, in 1861, in which locality Kingfishers are more or less abundant; at a later period he

observed, near Peel Forest, another specimen, which he is confident was not the well known *H. vagans*.

Mr. P.,—observed, February 15, 1870, at his station, in the Malvern Hills, a very dark Kingfisher sitting on the fence, but, as he was busy with his sheep, no attempt was made to secure the specimen.

It may be mentioned, that at localities so far inland as the Malvern Hills and Peel Forest, Kingfishers are far more scarce than near the coast, their appearance at any time would there be likely to attract notice. Under the circumstances, it would seem premature to expunge this second species of *Halcyon* from the list of native birds. Swainson named it; Hector is of opinion that he once shot a specimen; Buller makes a stand for it, and contests that the question of its existence here is undetermined.

The two friends whose observations have been communicated are both men who, as Hamlet says, "know a hawk from a handsaw" (*heronshaw*). May we keep it a little longer on our list?

No. 11.—Anthornis melanura, Sparrm.

(See also Vol. ii., p. 56.)

To the practised ear and eye, the sexes are readily distinguishable. This bird seems destined to play an important part in the distribution and propagation by seed of many introduced plants; within the last few years we have observed within the outskirts of the bush many flourishing specimens of *Ribes*, *Leycesteria*, *Hypericum*, etc., the seeds of which have been carried thither from our gardens and shrubberies.

The Koromako in the *Fagus* forests may be frequently observed ascending the bole of the black birch after the honey drops; its mode of climbing differs from that of the kaka, kakariki, tui, or piwauwau, its progress is assisted by a slight flutter of the wings. We have noticed some birds with the irides cherry or bright blood-red.

The following notes may throw some light on the question mooted by Dr. Finsch and Mr. Buller as to the value of the species, *A. ruficeps*, Pelzeln. August 7.—A Bell-bird (hen) on the camellias, head feathers of bright lavender-blue, quite a contrast to the dark purplish tint of well-plumaged males; it was some time before this gay marking could be satisfactorily accounted for, every likely plant in the garden then in flower was examined, but without success; in a few days many individuals were noticed adorned with the head feathers similarly coloured; it was at length (September 10) traced to the freshly opened blossoms of the native fuchsia (*Fuchsia excorticata*). March 10.—Saw a nest with young birds, about two or three days old; this is the latest brood we have met with. September 29.—Nest of *Anthornis melanura* just finished in the fork of an old *Cordyline australis*, hen carrying up lining feathers. October 2.—Nest contained three eggs; 3rd—hen sitting close; 13th—young

hatched, showing a period of about ten days for incubation. November 23.—Nest in a *Myoporum*, about four feet from the ground; the tree is at the edge of a path constantly used. The hen sits very close; we have gently removed her sometimes to look at the eggs, when this has occurred the cock bird has been hastily summoned; both birds have appeared very anxious, bustling about the nesting place, till the hen has thought fit to resume her duties, the cock bird still lingering about the nest till seeing his partner and her charge quite secure, he has darted off to resume his interrupted feast of honied blossoms.

In these advanced days, when female rights find redoubtable champions on every side, justice to our country induces us to criticise statements long since advanced by a worthy ornithologist, whatever may be the custom of birds in the old country as to the distribution of labour and accomplishments between the sexes, perhaps, from mysterious antipodean influences, a different regime prevails in our land of tree ferns and *Phormium*.

Pennant wrote,—"It may be worthy of observation, that the *female of no species* of birds ever sings; with birds it is the reverse of what occurs in human kind; among the feathered tribe all the cares of life fall to the lot of the tender sex, theirs is the fatigue of incubation, and the principal share in nursing the helpless brood; to alleviate these fatigues, and to support her under them, nature hath given to the male the song, with all the little blandishments and soothing arts; these he fondly exerts (even after courtship) on some spray contiguous to the nest, during the time his mate is performing her parental duties."

Some of the assertions contained in this quotation from the celebrated naturalist are not borne out by the habits of our native birds, briefly, the song of the female *Anthornis* is very often heard; unfortunately attempts to convey an idea of the sound of bird notes are always more or less incomprehensible, or rather *unutterable* failures, so no endeavour will be made here to write down her melody. Through the general harmony of song in the bushy gullies, one frequently hears the clashing of the female kingfisher's harsh notes. Thus much for the *accomplishments* of our females; it must be added, in all fairness to the sterner sex, that they *do* share in the labours of the family; the cock flycatcher assists in the fatigues of nest building, takes his turn in the duties of incubation and feeding the young—abundant evidence that *here* females are not mere drudges after all. With regard to the reason suggested for the male being endowed with the gift of song, it is admirable for its sentiment only it happens that we have listened with delight to the melody of birds long after the breeding season has passed away, when the cold winds in the shortening days of May have given warning that winter was at hand. In the higher alpine districts what changes occur in the voices of birds; with *A. melanura* this fact is very noticeable, to our ears its vocal efforts there are more pleasing than those of the dwellers in more favoured spots.

No. 15.—Pogonornis cincta, Dubus.

(See also Vol. ii., p. 57.)

The nest figured on Plate XII. was obtained from the bush near Kaiwarawara, in the neighbourhood of the city of Wellington, and is described in my previous Notes cited above.

No. B. 19.—Orthonyx (Mohoua) albicillus, Gml.

Hihipopokera.

Certhiparus albicilla, the nest figured on Plate XI. was drawn from a specimen obtained near Wellington, where the bird may be seen in considerable numbers; its habits so closely resemble those of *Mohoua ochrocephala*, that one sees with regret that ornithologists have lately seen fit to class it with another group. Description of the nest is given in Vol. ii., p. 59.

[It will be observed (*ante*, page 40) that both Buller and Finsch have agreed that this bird shall be placed along with *Mohoua ochrocephala*, under the genus *Orthonyx*.—Ed.]

No. 24.—Gerygone flaviventris, Gray.

Piripiri.

Warbler.

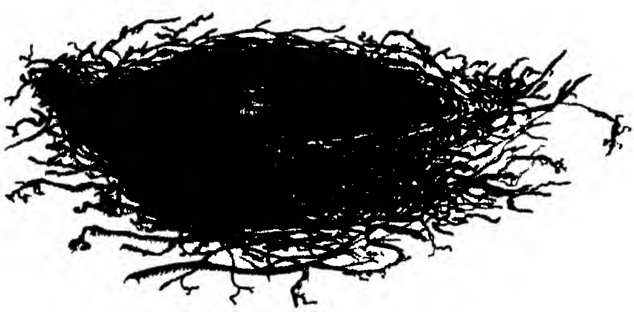
In the Notes on the breeding habits of New Zealand birds (*Trans. N. Z. Inst.*, Vol. ii., p. 59) the reason was given why *G. assimilis* was adopted as the specific name for the Warbler, instead of *G. flaviventris.* Considerable importance appears to be attached to the mode of nidification as a reason for making two species, as may be gathered from a foot note in Mr. Buller's *Essay*, p. 9, describing the nests and eggs of the Warbler; the eggs of *G. assimilis* are there said to be "marked at the larger end with reddish spots on a white ground, while the eggs of the other species usually number four, are about one-third less in size, and of pure white." In *Trans. N. Z. Inst.*, Vol. ii., p. 387, Mr. Buller writes,—"I am not aware that I ever met with *G. assimilis* in the South Island." To these notes it may be replied, that we have lately deposited in the Canterbury Musuem an interesting series of the eggs of this cheerful little warbler, all collected in the *South* Island, and taken from nests which, from their construction, would answer either of the descriptions given in Mr. Buller's essay; an inspection of these eggs will show their variation in colour from pure white specimens to others richly sprinkled with reddish marks; the white are *by far* the rarest eggs.

In the winter months, the Warblers may be observed busily exploring the outer sprays of manuka, or flitting over the fern-clad spurs, in diligent search for larvæ, or the eggs of insects securely packed away in their fine-spun silky

Nest of ZOSTEROPS LATERALIS

On Pteris aquilina

See Vol II Page 61



Nest of POGONORNIS CINCTA

See Vol II Page 57

J.B.Potts del. J.B. lith.

Printed at the Govt. Lithographic Press

wrappings, that protect them securely enough from the cold breath of winter as they lie hidden beneath the bending fronds of the brown *Pteris*, or amongst the slender twigs of the scented manuka, but defenceless against the quick eye and sharp beak of the Warbler. In early spring, whilst insects are yet scarce, these birds may be observed sometimes on the ground picking amongst the dead leaves that lie strewn beneath the overhanging shrubs; in the pursuit of flying insects they do not chase their prey in the air like the *Rhipiduræ;* but rather flutter about the tops and outsides of shrubs; whilst so engaged the snap of the mandibles may be plainly heard as they clear off their tiny prey. Perhaps it is a sign of attachment that at all seasons of the year, Warblers may be noticed in pairs, rarely is a solitary bird met with; in the breeding season, anyone straying near its home is met and watched by both birds, each in turn giving utterance to an anxious twitter.

Males have been noticed fighting with great resolution, sometimes on the wing, sometimes on the ground; after the skirmish, the rival combatants retired, each towards his favourite range in the gully, raising his tremulous jingling note as a song of triumph or defiance.

Last summer, two instances of the *Chrysococcyx lucidus* making use of the nest of the Warbler, fell under our observation, both nests were in garden hedges.

Sept. 19.—Warblers carrying material for a nest at Fernbrook; 23rd—the nest, built in a manuka, about 9 feet from the ground, appeared finished, without a porch; 26th—one egg; 30th—three eggs. Oct. 1.—Four eggs, white, spotted with red; 9th—hardset; all further observations stopped as to period required for incubation, bird or birds destroyed by a cat.

Having lately perused Gould's *Handbook*, and noted the range of the *Gerygone* on the Australian continent, the rarity of such a mode of construction in cool countries strengthens our views on the pensile nest builders—that form of nidification being the result of instinctive precaution against the egg robbers of tropical or semi-tropical countries.

Last Chrismastide, in the garden of a friend at Christchurch, a pair of the *Gerygone* had built one of their elaborately-finished structures, suspended from the branch of a currant bush; the result was one of the prettiest specimens of bird architecture, framed with green leaves, and decked with clusters of the deep red fruit, which hung about the nest untouched by the Warbler's beak. This fact is mentioned, because, since the numerous flocks of the mercurial *Zosterops* have made themselves rather dreaded than admired as visitors to the fruit gardens, in some instances we have noticed *nest taking* as the result, with not too much discrimination being exercised by the captors as to what species of small birds are really fruit-stealers. We have known the nests of those valuable insect-eaters, *Gerygone* and *Rhipidura*, esteemed as trophies taken from the enemy.

No. 29.—Petroica macrocephala, Gml.

(See also Vol. ii., p. 59.)

This confident little insect-eater is so tame that it not unfrequently may be seen on one of the croquet pegs whilst the game is being played; it is exceedingly quarrelsome; we have had almost to separate two combatants by hand before the victor could be induced to leave his panting adversary. At Rockwood, two were taken by the hand whilst fighting on the lawn, carried into the house, and on being released out of doors, at once recommenced hostilities.

Notes.—Aug. 21.—Cock bird feeding the hen; an act of delicate attention we suppose, as both birds were picking up grubs amongst the grass on the edge of the gully. Aug. 24.—Late in the evening a cock bird took up his station on the lawn mower, and commenced pursuing insects like a *flycatcher*, after each chase returning to the same perch.

The Tit often reminds us of the old fable of the Fox and the Crow; had the latter been as accomplished as the Tit, she need not have lost her piece of cheese, for we have seen the Tit repeatedly carrying a large grub in its bill whilst uttering its call-note.

The nest sometimes occupies weeks in its construction. August 18—saw birds building, the nest was not quite finished on Sept. 10th, when the foundation slipping through the long leaves of the *Cordyline australis*, it fell to the ground; Sept. 19– the birds were building a new nest. It was a very cold and late spring, which probably would be the reason for the tardiness of their proceedings.

Few of the native birds can be considered as very cheerful songsters, but there seems to us quite a mournful cadence in the note of this bird.

No. 33.—Petroica albifrons, Gml.

(See also Vol. ii., p. 60.)

The nest and eggs represented on Plate XI. are now deposited in the Canterbury Museum. This bird, as a songster, is perhaps unequalled by any native warbler, and we think scarcely surpassed by any of the woodland melodists of the old country; in its habits it is exceedingly tame; at a station on the Upper Rangitata, where it abounds, it is bold enough to enter the house, but there, it must be remembered, it is in the "back country," where the Englishman's "familiar evil spirit," *the cat*, as yet is comparatively scarce.

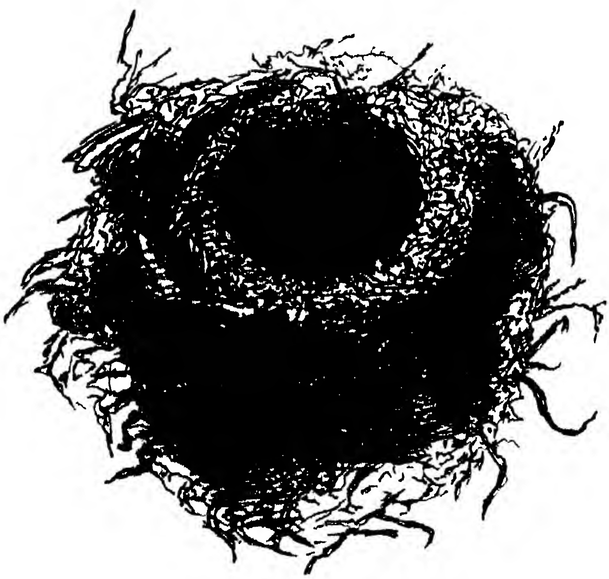
No. 34.—Anthus Novæ Zelandiæ, Gml.

(See also Vol. ii., p. 61.)

In the last volume of *Transactions*, mention was made of the occurrence of White Larks near the Waikerukini, in this province; they are not

Nest of PETROICA ALBIFRONS

See Vol. II. Page 60



Nest of MOHOUA ALBICILLA.

unfrequently met with in that neighbourhood. On Oct. 5, we saw a specimen that permitted a tolerably close inspection, this was on the track across the plains, within two miles of the place where those were observed last year; we have examined a beautiful specimen that was procured in that district. Is it probable that a marked variety will be established? Birds of this species that have been rescued from hawks have been so completely prostrated by terror that for some time they have been wholly incapable of flight, on being gently tossed in the air falling helpless to the ground. It is very sociable in some of its habits; we have counted seven or eight bathing together in a creek; it is usually observed in scattered companies.

No. 35.—Zosterops lateralis, Lath.

(See also Vol. ii., p. 61.)

It was suggested in my previous notes on this species, that possibly the sweet song of this bird was peculiar to pairing time; closer observation proves it may be heard through ten months of the year; we have noted the singing of the *Zosterops* from the 17th of August till quite in the autumn (May 4th). Sep. 20.—Crowds of Blight Birds in bushes of the *Pittosporum Colensoi*, busily employed about the woody capsules, picking off the gluten in which the seeds are embedded. The fruit of one of the native mistletoes, *Loranthus micranthus*, is a favourite food. The nest figured on Plate XII. was suspended to a *Pteris aquilina*, on a slope not far from the sea; it bore a striking resemblance to a swinging cot or hammock.

The *Zosterops* can be tamed without much difficuity; we know of an instance in which one of these cheerful little birds had been tamed so thoroughly that it keeps about the room, hopping about the table, and taking honey from the lips of one of the younger members of the household.

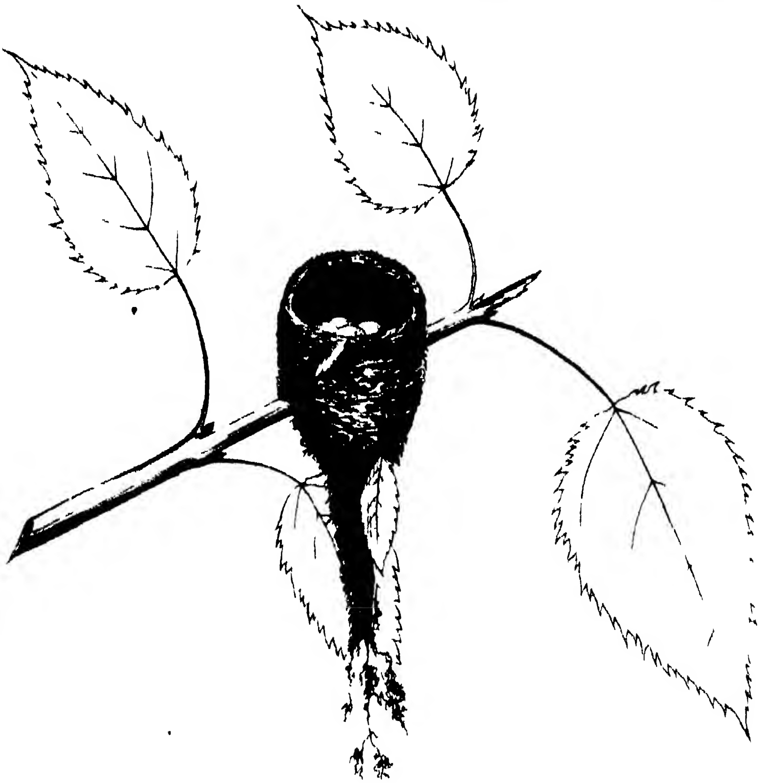
No. 37.—Rhipidura flabellifera, Gml.

(See also Vol. ii., p. 63.)

To the quiet observer of the habits of our bird-friends, but few sights can afford more gratification than watching the patient industry which is displayed, by the very energetic and useful Flycatcher, in the construction of its compactly-formed nest. The admirable instinct disclosed in the selection of the site has been already referred to, in the last volume. The nest is to be found near its food supply (for the young will make incessant demands on the exertions of the parent birds), and it seeks a sheltered position where insects "most do congregate;" it must at the same time afford "ample room and verge enough" for the numberless evolutions to be performed by the rapid fluttering of two pairs of most active wings, which are soon to be constantly fanning the lazy air. To meet these indispensable requirements, the security offered by the densely tangled thicket is most commonly neglected for the retirement that is to be found

beneath the high bank of some shady creek ; the bough usually selected stands out well from the main stem, not too close to other branches. The foundation of the nest is laid by adroitly securing the slender chips of decayed wood with lines of cobweb to the spray selected ; this delicate operation must of necessity be a work of great difficulty, "c'est le premier pas qui coute ;" in places where splinters of decayed wood were not to be obtained, we have noticed that the glumes of a coarse grass have been used instead. Who could fail to admire the persevering efforts of these little architects; what dexterity and cleverness have been employed in raising the frail platform on which is to be built the thick felted wall of the snug home. At the next stage, additional exertions are called forth ; from the variety of materials required, longer flights become necessary for their collection, mossy stones and roots are scrutinised, and places frequented by live stock visited ; fine grasses, thread-like roots, dead leaves or skeletons of leaves, hair, green tufts of moss with tiny imbricated leaves, and the down of tree ferns, are now wanted, crevices are searched, and the numerous holes before which "the murderous spider," lurking in the dark, has spread the treacherous net.

It is whilst collecting cobwebs that the plumage of the Flycatcher is exhibited to the greatest advantage ; hovering on the wing, the fan-like tail outspread to the utmost width, with rapid gyrations they move round the spot till enough has been secured for a load ; the quantity made use of would surprise those who have not witnessed these labours ; it is the most important element in felting ; in fact, it is the mortar of the future structure. Whilst building, the exterior of the wall is always kept higher than the centre of the nest, so that at an early stage of its progress it looks saucer-like in shape ; the birds (for both join in the labour, although the female appears to undertake the greatest share) try the strength of their work in every way ; it is well trampled, the webs are carried from the interior to the outside in festoons from left to right, and right to left, as far down as the beak can reach ; this working in of the web is persevered with throughout the entire building of the fabric, thus the materials are repeatedly braced together. As the wall rises, the bird, with tail elevated, is itself the mould by which the rounded cavity is beautifully shaped ; seated in the centre of the rising structure, it turns round repeatedly, fluttering the wings, which action keeps the wall pressed out to its proper shape, the head and chin is pressed on the top, the materials pulled in towards the centre ; this manœuvre is performed at frequent intervals. So earnest are these little workers that they scarcely rest for hours ; sometimes, by a sudden flutter, they obtain a few insects, or the creek is visited for water ; the cock now and then finds time for a brief twitter, moving its head from side to side, as if criticising or admiring the result of their united exertions, but quickly both are at work again. Whilst watching one of these birds drinking at the creek, with an air of such evident refreshment, it occurred to



Nest of RHIPIDURA FLABELLIFERA
On a spray of Aristotelia racemosa
See Vol II Page 68

Nest of PODICEPS RUFIPECTUS
Clearwater Ashburton
See Vol II Page 73

T.H.Potts del. J.B. lith.

Printed at the Gen. Govt. Lith. Press by J. Acres

us that the time of incubation is an interval of *necessary* rest between building the home and rearing the young, those times of incessant labour.

Towards the completion of the home, as it assumes a cup-like form, a still more abundant use of cobweb may be noticed, the festoons are multiplied, the wall being finished off with numberless ties and braces; the interior is now lined with fern-down, the slender fruit stalks of moss, or other soft material other than feathers, and the structure is complete, and admirably finished; it is warm, strong, and elastic, and so well felted that it is not easily pressed out of shape; it is a marvel of construction, effected by the beaks of two small birds which have had numberless other offices to perform; all their food during the time has had to be found and caught, assisted by no store of fruit or grain to supply their wants, requiring *only discovery*. A few notes are appended, which touch on the peculiar form of the nest of *R. flabellifera* in certain situations only; as far as our observations reach, several theories have been aired in order to account for this singular form of structure.

Jan. 2.—A nest was observed in a small plant of *Aristotelia racemosa*, just above the creek, by the farm buildings; the construction somewhat resembles the homes which have been figured of *R. albiscapa*, a portion descending in a tail-like form below the spray on which the structure is built. (See Plate VIII.)

The use of this appendage is not very clear, but we have observed that part of the creek where this nest was found has several bends in it; it is probable that at such a turn, sudden drafts or gusts of wind might, by agitating the spray, endanger the safety of the eggs in a nest, the cavity of which scarcely reaches 1 inch 6 lines in depth; would not the resistance offered by this peculiar addition lessen any such danger by diminishing the extent of the vibration? It may be asked how it is the instinct of the bird does not lead to the selection of a spot where such a precaution would be unnecessary; the answer to this is, that this particular place, from its immediate contiguity to the stockyard, bullock sheds, etc., offers special inducements to a purely insect-eating bird, as it affords an extraordinary food supply from the numbers of small insects which there assemble. This is the third example from the same locality.

Jan. 8.—The nest contains four young birds and two addled eggs, and is being enlarged by the addition of a slight rim all round the wall; the interior is kept clean by the old birds removing the white pasty excrement as soon as extruded by the young, dropping it a few yards off; 10th—the two strongest birds left the nest; a bell-bird which made some menacing darts at them was driven off by the old birds acting in concert; the young were fed on an average of about once a minute. April 26.—The fantails now frequent the house, clearing the rooms of flies, which they effect whilst on the wing, picking them off the curtains, ceilings, etc.; the most difficult feat appears to be in taking them off the side walls. August 6.—Saw *R. fuliginosa* with a

large insect, beating it several times against its perch (kingfisher fashion) before swallowing it; have also observed the foot used as a claw when feeding on a large fly. Oct. 1.—Found on a sapling *Fagus*, a union nest, on which was the cock (*R. flabellifera*); 2nd—the hen (*R. fuliginosa*) was on the nest; it contained three eggs; these, together with the nest, were taken, with very great reluctance, but it was thought they might help to convince anyone who was sceptical as to the two species breeding together; a fact that could not be established by the most assiduous study of preserved skins. So tame was the hen bird that it permitted the nest to be cut out of the young tree, carried from the bush over a gorse fence and ditch, without moving from her position till gently pushed off her eggs with the finger, her pied mate fluttering near, twittering what was doubtless a reproachful protest against such barbarous cruelty; 22nd—saw another nest similar in build to that noticed under date Jan. 2, depth of cavity only 1 inch 3 lines; from its situation at a *bend* in the creek, it would appear rather to confirm the idea that has been suggested as the reason which guided the little architects in making this curious addition to their neatly-built home. As far as we have observed, this mode of nidification is restricted to *R. flabellifera*, the species that approaches most nearly to *R. albiscapa*. Should not this lead to a closer examination of the specific differences which separate our pied Flycatcher from its Tasmanian congener. Perhaps the form of nest which ornithologists give to *R. albiscapa* may be exceptional, as in the case of *R. flabellifera*.

Oct. 23.—Found this afternoon a nest with only the foundation laid, about an inch in diameter, which was being built by birds that had a brood of three young ones to feed; 25th—scattered, in the vicinity of the nest, short lengths of different coloured wools, worsted, cotton wool, cow hair, white horse-hair, etc.; 26th—saw some of the material supplied yesterday made use of; 27th—nest completed, contained one egg, rim of the wall finished off with white horse-hair, pink wool, etc.; 28th—hen on the nest, cock singing close by; the hen left the nest, when the cock immediately took her place whilst she fed; 29th—three eggs. Nov. 14.—Four young hatched; 27th—young left the nest.

Jan. 7.—A union nest, in which were young birds in this instance; the cock was *R. fuliginosa*; 10th—the young birds had left the nest and were flying about the tree in which it had been built, with great vivacity; they exactly resembled the offspring of *R. flabellifera*, but showed even a greater share of activity; it was the most vigorous brood of Flycatchers we had noticed during the season. Was this superior display of energy owing to the cross between the parent birds? Is the alliance between individuals of distinct species at all common with any other genus of birds? We noticed that the cock bird *R. fuliginosa* was as assiduous in his attentions to his young family as the hen, notwithstanding the birds were of a different feather to himself.

Both of our species of Flycatcher remain with us during the whole year, merely shifting their quarters from near the sea level to the higher parts of the bushy gullies.

What is the habitat of *R. tristis*, Homb.? Where could one learn anything of its habits?

No. 51.—Nestor meridionalis, Gml.

Kaka.

(See also Vol. ii., p. 64.)

Our representatives of the gorgeously painted *Psittacidæ* possess little of the brilliancy of plumage or gracefulness of form which distinguishes so many of the family in other lands; our Kaka, in his suit of sober brown slightly flushed with red, might be passed over in a collection almost without notice by many to whom his quaint habits are unknown, and even to those who are most familiar with the bird, it conveys little if any impression in association with the parrot tribe; it is never called by that name except, perhaps, there is a desire on the part of some old settler to impress a new comer with a proper sense of having arrived in a foreign country, when our noisy Kakas are spoken of or pointed out as "our parrots."

Arboreal in its habits, with truth it may be said that our Kaka lives but amongst trees, not merely seeking the forest for the sake of the shelter in which to rest or to rear its young, but it finds its living on and amongst trees, and in the forest it may be found throughout the whole year; nor is the economy of the bush uninfluenced by the habits of this bird, as we shall presently endeavour to show. Although noisy and restless, the Kaka at times may be, and often is, observed as quiet as any bird in the bush. Let anyone ramble into one of our timber forests, far beyond the outside shrubby zone resounding with the cries of many birds, where all is so still and silent, and he will find that there are times, about the noontide hour, when the wanderer might almost dream that he had strayed beyond the reach of sound, with all its soothing tones and harsh discordances; that he might—

——— "In this desert inaccessible,
Under the shade of melancholy boughs,
Lose and neglect the creeping hours of time;"

all too soon the spell is broken, frequently by the wail of the ubiquitous weka, the clear ringing note of the koromako from the damp moss-clad gully, and quite as often by the hard-working Kaka dropping a chip of the rough hard bark that had been silently stripped from some lofty tree. It may be thought not out of place to make brief allusion to the influence which some of the habits of the Kaka exercise on the condition of the bush; admitted amongst the *Trichoglossinæ* as a honey-eating bird, in its search after this portion of its food, it may cause the fertilization of the blossoms of trees, and thus assist in

their propagation. Its love of insect food, and the toil which it undertakes for the sake of gratifying this appetite, which Nature has implanted in this bird, materially affect the economy of the timber forests it inhabits. Although so often accused of injuring trees by stripping down the bark, from careful observation we do not believe a flourishing tree is ever damaged by its beak; it is the apparently vigorous, but really unsound tree that is attacked, already doomed by the presence of countless multitudes of insects, of many varieties of which it is at once the food and refuge, either in their perfect or larvæ state.

In the persevering and laborious pursuit of this favourite food, the Kaka doubtless lends his assistance in hastening the fall of decaying trees, the loosened strips of bark, dissevered, admit to the exposed wood, rain, moisture collected from dews and mists to be dried by evaporation, by the heat of the sun, by the desiccating winds, only to become saturated again; under this alternation the insidious fungi take root, decay rapidly sets in, the close-grained timber gives place to a soft spongy texture, branches drop off, and gradually the once noble-looking tree succumbs to its fate; but its gradual decay and fall, the work of years, has proved beneficial to the surrounding plants, the dropping of the branches admits light and air to the aspiring saplings, assists in checking the undue spread of lichens and epiphytes, and when the old stem falls, tottering down from its rottenness, its place is supplied by vigorous successors. In estimating the value of its labours as an insect-eater, it should not be forgotten that the *Picidæ* family is entirely absent from our bird system, and that upon this indefatigable climber devolves some share of the duty of representing that peculiar group of forest birds.

Living in trees, when disturbed it hops amongst the branches with much dexterity, beak and wings assisting its awkward-looking but rapid progress as it threads its way amongst leaves and sprays with unruffled plumage; the peculiar formation of its grasping feet enable it to execute wonderful feats of agile climbing. A sharp short note or two marks its uneasiness when a vigilant eye watches what takes place below; when really alarmed, after a few hurried movements, it flies some short distance, at first start usually gliding downwards rather than flying straight, threading the leafy maze of the close-growing trees with perfect ease and grace, at this time it warns its fellows of impending danger by uttering loud oft-repeated cries of "kaka, kaka." In all probability it derived its native name from its alarm note. It can readily be imagined that in those times when only the rudest and least effective weapons were in use, long prior to the period at which the Maori became acquainted with the death-dealing gun, how frequently frightened or wounded birds escaped the uncertain missiles, uttering loud cries of terror; vexation or hunger would soon impress this call on the mind of the disappointed hunter. We have ever thought it a miserable sight to watch the Kaka, when severely wounded,

uttering its low smothered cries of distress and pain; how the wretched bird endeavours to save its fall from the leafy shelter by clinging to bough and spray with desperate tenacity, often seizing its wounded limb with its powerful beak, as if to tear away the burning agony from which it suffers. Truly gregarious, it is social even in distress; numbers gather round their wounded companion to fall easy victims to the gunner. Often in the bright sunshine, scores may be observed, with loud screams and chatter, flying and circling about, and, high above the outskirts of the bush, apparently bent on enjoying some short excursion; now and then an individual more hilarious than his fellows, after a somewhat slow and laboured ascent, will suddenly dart downwards, perpendicularly, with almost closed wings; this feat is doubtless performed to an appreciative and admiring circle, if one may judge from the clamour of the company.

The Kaka we think to be less gregarious when travelling than at almost any other time; when migrating from one part of the country to another, it proceeds on its journey at a considerable height, uttering at intervals a brief note that sounds something like "t-chrŭt, t-chrŭt," then, perhaps, a whistling call of "tweetie, tweetie." Kakas do not travel in large flocks, most frequently but two or three are to be seen in company, sometimes six or eight are seen together, solitary wanderers are not unfrequently observed; when their cry is imitated it is often replied to. Their steady, slow, and somewhat laboured flight when journeying is not to be mistaken for that of any other native bird that we have observed on the wing; there is a methodical painstaking style that affords quite a contrast to their gay, rattling, off-hand soaring and gliding about the bush; it exhibits the proper difference of behaviour to be assumed under business-like and pleasure-taking aspects. Man is not the only biped enjoying the privilege of duality. In dull, moist weather, when the strange-voiced tui is silent, the Kaka is perhaps more noisy than usual; its call is heard at the earliest dawn, even in the night it is not always silent.

When matched, the pair may be observed constantly together; if one moves from a tree its attentive partner quickly follows. The nesting place has to be prepared; for this purpose a tree is usually selected the heart of which is completely decayed; it must have a convenient hole leading from the outside to the bottom of the hollow; the interior requires some preparation perhaps, or the entrance has to be smoothed or enlarged; the pair may be frequently observed busy for the comfort and safety of their prospective offspring, sometimes a certain degree of fastidiousness is disclosed in making these preparations. After a home is made ready, it often happens that in place of being occupied it is deserted for some more eligible locality. It lays its four white eggs on the decayed wood, without any further supply of softer material by way of nest. As an instance of devoted attachment to its young, it may be mentioned that we have found the old bird dead at the entrance of its nesting

hole after a bush fire, in which it had perished rather than desert its helpless offspring, yet, from the nature of the locality, escape would have been easy.

The summer time is occupied by the cares of providing for and protecting the young; after they are old enough to shift for themselves, as autumn advances, the Kaka usually becomes very fat; as it is considered savoury food, great numbers are annually destroyed. It is in winter time that it appears to the greatest disadvantage, especially during a severe winter in our Southern climate, when the bush is metamorphosed with fantastic snow-wreaths, it seems out of character with the scene; food may be scarce, for with ruffled feathers it sits moping and nearly silent, a picture of dull melancholy. Towards the close of winter (August) we have known it devour with avidity the hard seed of the kowhai (*Sophora tetraptera*); at this period gardens and shrubberies are visited, and blossoms of almond trees and flowering shrubs eagerly ransacked; as winter passes away with its coarse fare, returning spring restores the Kaka's sprightliness, and he begins to fare daintily. In September we have observed it poised on the slender bough of some tall *Panax*, luxuriating on the viscid nectar of its blossoms; happy enough it looks when thus seen through some opening in the bush, its deep red breast-feathers lit up by the slanting rays of the declining sun; sated at last, it cleanses its huge beak against a neighbouring bough, then, with grateful chatter, glides off to join its fellows.

Insects form no inconsiderable portion of its food, how diligently they are sought for may be judged from the heaps of bark chips that lie beneath decaying trees; often it may be noticed on the ground tearing away the mossy clothing of the huge gnarled roots that spread around, even the soft rotten boughs are gnawed to obtain the larvæ of some of the larger bush insects. Not only does it regale on flowers and insect food; in the *Fagus* forests, in the bark of the black birch trees may be found a dull red fleshy-looking grub, tightly embedded in the hard bark, quite beneath the black velvety moss that wraps the *Fagus* like a pall; the wound made by this unsightly insect causes in spring time a sweet honey-like exudation, most frequently taking the form of a fine white filament, terminating in a small bright globule, glistening like a dewdrop; glancing upwards, the tall straight-grown stem appears spangled with multitudes of these bright threaded beads. This is a favourite feeding ground of several arboreals. The varied modes of locomotion employed form an interesting study, leading to enquiry and reflection upon their structure, their muscular and osseous systems, thus opening out a wide field for physiological observation. Of these hungry climbers the robust-framed Kaka occupies the foremost rank for size, its hold on the bole of the tree is secure, its movements deliberate, whilst its thick tongue is actively employed in gathering the honey-sweet meal.

The Kaka is easily snared, and very soon becomes tame if allowed liberty

about the premises, its ready confidence quickly transforms a pet into a plague. Let those who doubt its omnivorous propensities allow it access to a dairy, and watch the deft manner in which it manages to clear the cream from the pans.

Having entered so minutely into the habits of a bird so well known as the Kaka, it appears unnecessary to append a description, further than a few words about the tongue, etc., as some doubt has existed as to its position as one of the *Trichoglossinæ*, and whether its tongue is furnished with a brush-like termination or not. The tongue is thick, fining down towards the point, not unlike a finger; the superior side is flattish, the under side is rounded and furnished with a row of short stiff papillæ, black in colour; this brush-like apparatus can scarcely be said to form the termination of the tongue, it really occupies a similar position on the tongue which the margin of the nail occupies on the human finger; on the inside of the lower mandible may be observed, just within the deeply channeled lip, a row of minute yellowish dots, very slightly raised above the surface of the mandible; at the sides these specks give way to very faintly marked furrows, probably to clear the papillæ by the pressure of the tongue against the lower mandible. Those who have only seen dried skins, may not be aware that the upper and lower mandibles are connected by a thin tough skin, which allows the beak to open widely, and gives great freedom to the movements of the lower mandible; about the middle of this skin, in a line with the gape, a shallow sac or pouch exists, containing a wax-like substance.

Having only recently enjoyed the pleasure of reading Gould's *Handbook to the Birds of Australia*, we were not aware how little was known of the Kaka; a desire to carry out a wish therein expressed for further information about this bird must form the apology for entering so minutely into its habits. A difficult task it would be, even for an accomplished ornithologist, to give anything like a strictly accurate description of the Kaka's plumage, which should at the same time be supposed to represent satisfactorily and correctly the appearance of that of the species; so great is the variation in numerous minor points, that it offers great temptations to subdivision. As children, we used to be told that no two leaves were precisely alike of the gold and green mass that made up the foliage of the variegated sycamore; we have been reminded more than once of this piece of folklore when looking at a number of our parrots. Mr. Buller, in *Essay* (p. 11), alludes to several varieties in the feathers of the Kaka. Most noticeable must this variation of plumage appear to those who have enjoyed opportunities of inspecting specimens which have presented a change and difference of feather so remarkable as in those birds which, under the names of *N. superbus* or *N. occidentalis*, have been classed as separate species. Here is a change indeed; instead of the accustomed dress of sober brown, relieved from positive dulness by an olive shade, our usually demure-looking friend appears decked out in bright trappings of canary yellow with

scarlet facings. Is it to be wondered at that the assumption of a livery so gay and parrot-like metamorphosed our Kaka past recognition, even by old friends? In spite of his beak he was christened *Superbus*, and cut off by this distinction from the rest of the noisy fraternity. It is not known whether this gaudy clothing is enjoyed by a select body of individuals doomed to a life of celibacy, but it is certain that their numbers do not increase.

The following description is taken from a very fine old male, but a careful inspection of many birds of this species would convince anyone how very unsatisfactory must be the description of any one specimen as a correct representation of the species:—Upper surface olivaceous brown, often with a sombre greenish glint, each feather margined with dusky brown, feathers projecting over lower mandible, with produced hair-like tips, dark red with a stripe of grey; ear coverts rich orange; crown of the head, forehead, grey; back of the head grey, washed with pale yellowish green, margined with brown; nape rufous brown, margined with greenish yellow and black, forming an irregular collar, somewhat interrupted on the front of the neck; scapularies dark olivaceous brown, inclining to greyish green on the back; primaries brown, toothed with pale red on the inner web; tail dull brown, barred with pale red on the inner web, except the two centre feathers, the greater part of the basal portion of which are flushed across with a reddish shade on the under side, tipped with the same colour; throat, neck, and breast greyish brown, margined with dark greenish brown; abdomen and tail coverts rich blood red, barred with black; bill curved from the base.

No. 53.—Nestor notabilis, Gould.
Kea.
Green Mountain Parrot.

In order to convey a correct impression of the Kea and its habits, it is necessary to give a brief outline of the features of the country in which it is to be found. Where we have most frequently observed it has been far above the Gorge of the Rangitata, one of the great *snow rivers*, as they are termed. This stream, which derives its source from the glaciers which are embedded in the gloomy and secluded fastnesses of the Southern Alps, is periodically swollen by the melting of the snow and by the heavy rain from the north-west, which falls during the spring and autumn months; fed by numerous creeks and tributaries from every converging gully, its volume increases, it rushes noisily and impetuously over its rough boulder bed, till the junction of the Havelock and the Clyde swells its waters into a large river. The leafy, rugged mountains which imprison it present almost every conceivable variety of outline; jagged peaks crowned with snow; countless moraines point out where the avalanche and snow slip have thundered down into the valley below. The river is bordered here and there by grassy flats or hanging woods of timber

Nesting place of NESTOR MERIDIONALIS.

Nest of OCYDROMUS AUSTRALIS.
See Vol. II, Page 70.

E.H.Potts, del. J.B. lith.

Printed at the Gen. Govt. Lith. Press.

trees, in which the brown tinted totara, the silvery *Phyllocladus* with its purplish points, the small leaved kohai, and the soft bright foliaged ribbonwood contrast well with the dusky hue of the dark leaved *Fagus*; far above, dwarf vegetation, in all the wonderful variety of alpine shrubs and flowers, struggles up the steepest slopes, adorning the frowning precipice and foaming cascade, lending its aid in forming scenes of picturesque and romantic grandeur, in which rich and varying tints of perennial verdure gratify the eyes of the spectator with their beauty. This is the home of the Kea. Amongst holes and fissures in almost inaccessible rocks, in a region often shrouded with dense mists or driving sleet, where the north-west wind rages at times with terrific violence, here the Green Parrot may be observed, entering or leaving crevices in the rocks, or soaring with motionless wings from peak to peak, far above the screaming kaka or the chattering parroquet; the swift-winged falcon is perhaps the sole intruder in its wild domain.

At early dawn its peculiar note is heard, very like the mewing of a cat, though in some of the more secluded gullies it may be noticed throughout the day; it really appears to wake up into activity at dusk, being, to a certain extent, nocturnal in its habits. It is scarcely less gregarious than its congener, *N. meridionalis*. In the moonlight nights of winter, numbers have been observed on the ground feeding. It can hardly be deemed an arboreal bird in the strict sense of the term.

The rigour of a hard winter, when the whole face of the alpine country is changed so as to be scarcely recognizable under a deep canopy of snow, is not without its influence on the habits of this hardy bird; it is driven from its stronghold in the rocky gully and compelled to seek its food at a far less elevation, as its food supply has passed away gradually at the approach of winter, or lies buried beyond its reach. The honey-bearing flowers have faded and fallen long before, the season that succeeded with its lavish yield of berries and drupes that gaily decked the close-growing *Coprosmas*, the trailing *Pimelias*, or the sharp-leaved *Leucopogon*, has succumbed to the stern rule of winter; nor has this change of season affected the Flora of the Alps alone, the insect world, in a thousand forms, which enlivened every mountain gully with the chirp and busy hum of life now lies entranced in its mummy state, as inanimate as the torpid lizard that takes its winter's sleep sheltered beneath some well-pressed stone. Under the effects of such a change, that cuts off such a supply of food, the Kea gradually descends the gullies, where a certain amount of shelter has encouraged the growth of the kohai that yields its supply of hard bitter seeds, the beautiful *Pittosporums* with their small hard seeds packed in gluten, and the black-berried *Aristotelia*; these and numerous other shrubs, or trees, such as the pitch pine and totara, furnish the means of life to the Parrot. It is during the continuance of this season that we have had the best opportunities of becoming somewhat familiar with it.

Within the last few years it has discovered the out-stations of some of the "back country" settlers. Of course, every station has that indispensable requisite, a meat gallows; it has found out and fully appreciates the value of this institution, as occasionally affording an excellent supply of food; the gallows is generally visited by night, beef or mutton equally suffer from the voracity of the Kea, nor are the drying sheepskins despised. These visits may be looked upon quite as social gatherings, as it is by no means a rare occurrence for a score of noisy Parrots to be perched on the roof of a hut at one time. A son of the writer obtained some fine specimens by means of a very simple snare—the noose made of a slender strip of flax leaf attached to the end of ricker or rod; he describes them as exhibiting great boldness and confidence, clambering about the roof of the hut, allowing a very close approach; when caught they remained quite still, without any of the noisy fluttering which usually accompanies the capture of birds, even when managed with adroitness; they preserved this quiet demeanour till the noose had been removed. One of these birds was placed on the floor under an inverted American bucket, the places for the handle not permitting the rim of the bucket to touch the ground; the Kea taking advantage of this, wedged its long beak into the space, using its head as a lever, it moved the bucket, raising it sufficiently to effect an escape from its prison.

On the other side of the river, just opposite to where this is being written, one station is greatly favoured by these visitors; during the winter season they become a perfect nuisance. On one occasion the hut was shut up, as the shepherd was elsewhere required for a day or two, on his return he was surprised to hear something moving within the hut; on entering, he found it proceeded from a Kea, which had gained access by the chimney; this socially-disposed bird had evidently endeavoured to dispel the ennui attendant on solitude by exercising its powerful mandibles most industriously; blankets, bedding, and clothes, were grievously rent and torn, pannikins and plates scattered about, everything that could be broken was apparantly broken very carefully, even the window frame had been attacked with great diligence; in fact the bird gave a new reading to that moral line of warning,—"For Satan finds some *mischief* still for *idle* hands to do."

Notwithstanding the high character various individuals of the species have earned for occasional indulgence in mischief, several have been kept as pets,—not in wooden cages by-the-bye, for a Kea has been seen by his gratified captor to eat its way out of such a place of confinement almost as quickly as it had been coaxed to enter into it. Two which had been tamed by a neighbouring friend were permitted to wander at large, they regularly returned to the house for their meals, and then rambled away again, scrambling and clamouring amongst the trees and outbuildings; any kind of food appeared to suit their accommodating appetite, but a piece of raw meat was evidently the *bonne bouche*.

On the level ground its mode of locomotion is very peculiar, it is not so much a walk as a kind of hopping jump, which imparts a very odd appearance to its gait; but when its strong climbing foot is observed, this is not to be wondered at; at a glance it will be seen how inferior is the strength and power of the two inside, in proportion to that of the outer toes; the short tarsi are also unfitted for walking.

In addition to the superior size of the bird and the colour of its plumage, the beak presents a marked contrast to that of the kaka; it is smoother, less curved, and much slighter, with a length of 2 inches from the gape to the point; the upper mandible, at the widest part,—that is in a line with the nostrils,—measures $5\frac{1}{2}$ lines in width, with a height of 7 lines. In flight and voice the two species greatly differ. There is no doubt the Kea breeds in the crevices of its rocky haunts; the kaka occasionally rears its young amongst rocks also. The eggs of the Green Parrot are as yet, we believe, amongst the desiderata of the New Zealand ornithologists.

Although comparatively few people are acquainted with the bird, it is not on that account to be considered rare; the reason it is so little known is, the remoteness of its habitat from the centres of population; it certainly appears to be very local in its distribution; a straggler now and then has been observed far from its usual haunts, for in one instance we have a note of its occurrence at the Hororata, in the Malvern Hills, close to the edge of the Canterbury Plains. Its beak can inflict a severe wound; a friend of ours, incautiously handling a pet, had his thumb bitten through by its powerful mandibles.

The following descriptions are taken from two specimens obtained on the banks of the Havelock; their crops were well filled with seeds of a *Pittosporum*.—

Male.— Bill smooth, curved; upper mandible dark horn colour, lightest at the culmen, approaching to black near the base, the inside marked with slight longitudinal furrows; lower mandible yellowish on the sides, furrowed on the inside; sere, covering the base of the upper mandible at its widest part, measuring 5 lines; nostrils raised or swollen; upper part of the plumage dull green with a silvery shade; shafts of feathers dark brown; feathers tipped sometimes margined with dark brown; forehead brownish green; feathers which rest against the gape produced into hair-like points; under parts dull silvery green with brownish wash; nape silvery green with almost a collar of dark brown; quill feathers, the third and fourth are the longest in the wing, dark brown, the basal part of the four first feathers blue on the outer web; inner web dark brown toothed with pale yellow; the rest of the primaries of a brighter blue on the outer web; secondaries bluish green on the outer web, inner web brown, toothed irregularly with pale yellow; under wing coverts yellow and bright scarlet slightly tipped with brown; tail, shaft of feathers produced beyond the web, dull green shot

with blue, with a broad mark or band of dark brown near the end, tip pale brown, inner webs toothed with yellow, under side of tail feathers washed with yellow; lower part of back and upper tail coverts green, shaded with dark orange-red margined with brown; vent and under tail coverts yellowish green. Bill, following the curve from gape to point, 2 inches; wings from flexure 12 inches 9 lines; tail 7 inches 7 lines; tarsus 1 inch 7 lines; largest toe with nail 2 inches 3 lines; total length, from point of bill to extremity of tail, 21 inches.

Female.—The plumage is rather duller than that of the male, the under nape of neck closely marked with dusky brown. Bill 2 inches; wings from flexure 12 inches 4 lines; tail 7 inches; tarsus 1 inch 5 lines; largest toe and nail 2 inches 3 lines; total length 20 inches 9 lines.

Another male, procured in the same locality, presents no marked difference in plumage, but is rather smaller in dimensions.

No. 56.—Stringops (Strigops) habroptilus, Gray.
Kakapo.
Ground Parrot.

Numbers of skins of this beautiful and remarkable Parrot have been received at the Canterbury Museum, from Westland, during the last two years. The size of the specimens varies; one of the finest gives the following dimensions:—Bill from gape 1 inch 7 lines; upper mandible at the greatest width 9 lines; wings from flexure 10 inches 7 lines; tail 7 inches 3 lines; tarsi 2 inches 3 lines; longest toe with claw 3 inches 3 lines; total length 29½ inches.

An addled egg of the Kakapo was also received in the course of the last summer, the whiteness of the shell much discoloured; its shape is not unlike that of the kaka, the larger end being broad. Its length is 1 inch 11 lines, with a breadth of 1 inch 5 lines.

No. 57.—Eudynamis Tahitiensis, Gml.
Kohoperoa, Koekoea.
Long-tailed Cuckoo.

About midsummer is usually the time when we first hear the call of the Long-tailed Cuckoo, who annually pays us a very brief visit, departing, as we believe, before signs of autumn indicate that the waning power of summertide is nearly expended.

It is not a rare occurrence for two or more of these handsome birds to be observed in company, or even disporting themselves in the same tree; this apparent sociability is perhaps really the effect of that remarkable instinct which guides migrants to so close an observance in the date of their annual arrival, and may thus account for several being seen together.

We are not in a position to afford much information of its breeding habits, although we have had several opportunities of seeing, and also of examining,

young birds which have been obtained in both islands; the young birds that have come under observation in this district have made their appearance in the month of March, which gives an indication as to the breeding season. Although its flight is peculiar, with a very rapid motion of the wings, we have known it on several occasions to have been mistaken for a hawk. Last March, we noticed a young bird near Mt. Somers, at no great distance from the *Fagus* bush of Alford Forest; it maintained its rather awkward flight but a short distance at a time, alighting heavily on the ground, and turning each time it settled, so that it faced the direction from whence it flew.

A specimen obtained in Ohinetahi, at Christmas time, measures as under·—Beak from gape 1 inch 8 lines; upper mandible horn colour, curved, hooked at the point and reaching below the lower mandible, which is yellowish; nostrils pierced close to the base, head feathers reaching to the nostrils; wings measure 8 inches, first feather short with outer web exceedingly narrow, third and fourth feathers longest; tarsi defended with imbricated scales, measures 1 inch 3 lines; toes, three in front and one behind, covered with scales, armed with curved claws of dark horn colour; entire length from tip of beak to the extremity of the tail 1 foot 6 inches, of which the tail measures 9 inches; upper surface is of a rich bright brown, barred across with rufous brown; the top of the head brown, marked with streaks of rufous, a streak of buffy brown extending from nostril over and behind the eye; neck barred with rufous, the end of each feather bearing a spot of lighter brown near the tip; wing coverts brown, barred with rufous and very slightly tipped with white; tail dark brown, banded with rufous, tipped with white, inner webs palest; under surface white, with brown streaks down the centre of each feather; thighs buffy, feathers pointed with brown; under tail coverts white, with bars of dark brown.

There are several specimens of young birds in the Museums of Wellington and Canterbury; the plumage differs much from that of adult specimens, being warmer in tone, especially on the under surface, and the upper surface presents a spotted appearance.

The young have been supposed a new species, which is not surprising when the general contrast of the plumage in the two states is considered. One of the youngest specimens we have seen, measuring from tip of beak to extremity of tail 12 inches 3 lines, has the upper surface dark brown; feathers barred with pale brown, spotted with buff; wings with a spot of buff at the extremity of the outer web; under surface warm rufous, with streaks of brown.

The Long-tailed Cuckoo visits the alpine districts, where, during summer time, its remarkably shrill note is not unfrequently heard. It should be mentioned that, unlike the bronze-winged cuckoo, its occurrence in the more cultivated neighbourhoods is rather rare. In the bush its movements are restless, but its habits are not those of a shy or wary bird.

No. 60.—Coturnix Novæ Zelandiæ, Quoy.
Koreke.
Quail.

(See also Vol. ii., p. 66.)

The most useful and important order, *Gallinæ*, has here but one indigenous representative, in the once well known, but now rare Quail; the rapid declension in its numbers, and indeed, threatened extermination, may fairly be dated from the settlement of the European population in these Islands.

Bush fires in our southern districts have been the chief cause of its disappearance; many settlers profess to believe that stocking runs with sheep occasioned its destruction. To this we demur, for the effect of extensive bush fires on the habitat of this excellent game bird, has come under our own personal observation. In the early part of the year 1857, a large part of the country on the southern side of the Ashburton, high above the gorge, had been burnt in the previous year; on the opposite, or northern side, known now as Clint Hills, the grass presented no signs of ever having been fired, and abounded with Quail—they were flushed every few yards; whilst we never saw a Quail on the opposite bank of the river, *their food* and shelter having been alike destroyed. Not a sheep had been on either side of the river.

But though very rarely met with, yet it is occasionally observed in several remote and secluded localities. We have had the good fortune to be presented with some fine specimens which had been procured from the neighbourhood of "The Paddock," on the West Coast road from Christchurch to Hokitika, a locality where they appeared in considerable numbers for some time.

The male has the upper surface ferruginous brown, with varied black and dark brown markings, a narrow whitish streak following each side of the shaft of each feather; top of the head rich brown, streaked with very dark brown, buffy-marked feathers intermixed; beak horn black, except at the extreme point; nostril covered with membrane; a line over the eye, cheeks, and throat, rufous, with a faint blackish curved mark just above the line of the gape; primaries dull smoky brown; secondaries edged with pale brown, marbled on the outer web with buff and dark brown; under surface ferruginous; breast marked with black and white; abdomen white; thighs buff; irides bright hazel-brown; tarsi dull flesh colour. Bill from gape 8 lines; wing 4 inches 9 lines; tarsus 9 lines; length 8 inches 3 lines; weight 7¾ ounces.

The female is not so rufous about the cheeks and throat, has a darker tinge of colour generally; abdomen almost buff. Weight barely 7 ounces. The feathers on the thighs are light and flocculent, those on the abdomen are slaty black, tipped with white, or buffy white, so closely arranged as to give that part of the bird a whitish or buff colour.

Although the sexes differ but little in point of size, yet they are easily

distinguishable by their general tone of colour as well as by the rufous cheeks of the male. On the ground their movements are active; sometimes they may be seen indulging in a dust bath as they lie basking in the sun; unless suddenly startled they almost always maintain that plump rounded appearance which characterizes several genera of the *Tetraonidæ*.

From tolerably close observation, we are inclined to suppose that their organs of hearing are far less acute than those of sight; they often give utterance to a low purring sound, that one might suppose to proceed from an insect rather than from a bird. The call is indulged in most frequently during moist or wet weather; it sounds something like "twit, twit, twit, twee-twit," repeated several times in quick succession. In very stormy, gusty weather, these birds appear dull and silent, secreting themselves amongst thick tussocks. When flushed, they do not rise perpendicularly, but still very straight for a few feet from the ground.

In confinement, they are fond of picking about amongst sand, and thrive well on soaked bread, grain of various kinds, and the larvæ of insects; the male is not an attentive mate at feeding time, and where several are kept in the same enclosure, constant little bickerings take place without actual hostilities being indulged in.

The eggs require twenty-one days incubation, and the chicks are most active directly they emerge from the shell. They grow very rapidly; at about four months old the young cannot very readily be distinguished from adult birds, either by contrast of size or plumage.

The Hon. J. C. Richmond saw Quail in the Taranaki District, in the months of November or December, 1869.

A fair correspondent forwarded two beautiful specimens of the egg (one of which was unfortunately broken in the course of transit), which were obtained in the Waitaki District.

Examples of the egg have been found buffy white with brown splashes.

In the early days, on the plains near the Selwyn, a bag of twenty brace of Quail was not looked upon as extraordinary sport for a day's shooting.

No. B. 65.—Anarhynchus frontalis, Quoy and Gaim.

(See also Vol. ii., p. 68.)

Thinornis frontalis, G. R. Gray.—*Gen. B.*
Charadrius frontalis, G. R. Gray.—*Ibis*, July, 1862.
Hæmatopus frontalis.—*Trans. N. Z. Inst.*, Vol. i.

This wader was first made known to science under its present name, by MM. Quoy and Gaimard, having been observed during the expedition of the "Astrolabe," undertaken in the years 1826–29, by order of the King of France. It is also thus recorded in the "List of the Birds of New Zealand and the adjacent Islands," in Dieffenbach's work. Again, by G. R. Gray (*Ibis*,

July, 1862), we find this bird mentioned under the name of *Charadrius frontalis*, with this very remarkable note: "The bird is represented in the *Voyage of the 'Astrolabe,' with a deformed bill, the bill is perfectly straight in most specimens.*" Where could the author have met with those specimens with perfectly straight bills? or rather, which of the waders or plovers passed for the *Anarhynchus?*—perhaps *C. bicinctus.*

I have lately had the pleasure of perusing a very interesting pamphlet, *On Rare or Little-known Limicolæ*, by Mr. Hastings. F.L.S., etc., who appears to have taken great pains in gathering together all the information he could collect about this peculiar-looking bird, and also gives a careful description of a specimen, in which he unquestionably makes the best of the slender materials at his disposal.

Still, as something like mystification might yet be thought to surround the history of this very interesting species of the large Grallatorial family, I have had much pleasure in presenting to the Museum, specimens of the adult, and also the young bird in the state in which it may be found probably some ten days from the date on which it emerged from the shell.

These specimens were obtained on the shingly bed of the Rakaia, which is one of the largest of the *snow* rivers that intersect the Plains of Canterbury. The *Anarhynchus*, be it understood, is not confined to that locality, in fact it is of frequent occurrence, and may be observed during several months of the year at least, near the streams or back-water of almost any of the rivers, which in their course disclose sandy spits and wide areas of shingle.

With regard to its breeding habits, I am unable to add much to the information which is given in my Notes "On the Birds of New Zealand." —(*Trans. N. Z. Inst.*, Vol. ii.) The young, if undisturbed, remain for some time near the spot where they were hatched; to escape observation they lie concealed behind stones, etc.; should an attempt be made to molest them, they start off with considerable celerity, uttering, at the same time, a shrill piping cry of alarm. When hard pressed, they take to the water; we have known them to cross a stream of considerable volume. The parent birds never appear to separate far from each other during the period of incubation; on being disturbed, they exhibit a peculiar habit of partially extending the wings, the effect of which is that they assume a broad and flattened appearance across the back, the head at the time being carried very low, the bill just clearing the ground, whilst a low purring sound is emitted. So tame does the *Anarhynchus* become under the influence of parental instinct, that after eggs have been picked up, examined, and replaced on their unsheltered sandy bed, I have seen the old bird immediately resume her duty of incubation, although I may have removed but a few paces distant and remained in sight for some time.

Having thus glanced at the favourite habitat, etc., of the Crook-billed

ANA[illegible]YNCHUS FRONTALIS

same

Plover, I will now proceed to describe these specimens; the first, that of an adult male, probably in its second year—bill black, longer than the head, pointed, curved to the right or off side, curled slightly in itself in a leaf-like manner, a long groove on each side of the upper mandible, the nostrils long, pierced not far from the base of the bill, fitted with a membranous process, which, apparently furnished with a system of nerves, extends some distance along the mandible; interior of both upper and lower mandible concave or sulcate, which form is maintained to the point; thus, the inside of the bill, when the mandibles are closed, becomes a curved pipe, with a very slight twist; the sharp edges of each mandible are horny and semi-transparent; from the base of the bill the upper mandible is flattened on the top for a distance of about 6 lines, it then assumes a raised and slightly rounded form, till it gradually sweeps down into the point; forehead, chin, and the whole of the under parts white, with a broad irregular band of blackish feathers stretching across the breast, widest on the left or near side; above the bill, from eye to eye, runs a narrow strip of very pale brownish colour; crown of the head and upper surface of the body ash grey; wings long and pointed; primaries dark brown, outer narrow vane of each primary darkest; shaft of feathers distinctly white; first feather longest; tail moderate, ash grey, middle feathers inclined to brown; legs gartered, or naked just above the tarsal joints; legs and feet a peculiar tint of black-green with a grey shade; toes three to the front and none behind, united at the base by a membrane extending to the first joint, bottom of toes greenish brown, middle toe and nail longest, nails short and black. Bill measures 1 inch 2 lines; wing 4 inches 9 lines; tarsus 1 inch 2 lines; middle toe with nail 11 lines; total length 8 inches 5½ lines.

The chick above mentioned is covered with freckled grey down; under surface silky white; wings pale brownish; the deflection of the bill easily distinguishable. Bill measures 6 lines; tarsus 10 lines; middle toe with nail 8 lines; total length 2 inches 8 lines.

Birds of the year do not assume the black band; females differ little from the males in size, the band is not so conspicuous, as it is much narrower than in the male; fine old males have the breast band broad, and that on the forehead dark brown. I have never seen this bird assemble in large flocks like *C. bicinctus.*

The peculiar formation of the bill has apparently induced naturalists to exhibit considerable doubt as to the proper position of this, perhaps, unique species. Without referring to all the notices of this bird which have appeared at different times, it may be mentioned that at least one eminent ornithologist considered the bill to be an accidental deformity; again, it has in some way been confused with *C. bicinctus*, from which it differs materially, in habits as well as structure.

A consideration of the natural features of its favourite haunts permits us to indulge in surmises as to the convenience and adaptability of its remarkable form of beak for obtaining its food. Where we have seen it has never been far from water, and if, as we presume, this bird is peculiar to this country, we can point to our larger river beds as affording it admirable feeding grounds. These rapid shallow streams are perpetually wandering and shifting in their course, cutting new channels after every freshet, whether occasioned by heavy rainfalls or by the melting of snow from the alpine crests of the "back country." Anyone acquainted with our "plains" must have observed, here and there, how certain parts (termed by geologists, "fans"), are thickly covered with stones—as, for instance, some miles below the Gorges of the Rakaia or Rangitata;—however unpromising or useless they may appear to the inexperienced, the practical grazier is aware that those stones assist in keeping the ground cool, and in retaining beneath them a certain amount of moisture which, during the drier portion of the year (when the parching north-west winds prevail), thus invigorates the thirsty rootlets of many valuable grasses, and the result is the maintenance of a fair number of sheep on this rather barren-looking stretch of country. When any of those stones are disturbed from their bed, who can have failed to notice the commotion produced amongst the insect community thus suddenly disclosed to view; what scuttling ensues to gain fresh concealment from the garish light of day. In a somewhat similar manner, after a stream has deserted its temporary bed, in all probability numerous forms of aquatic insect life, attracted by the moisture, are to be found in the sand in which the shingle lies half imbedded. The horny point of the bill of this bird, from its peculiar form, is sufficiently strong to be used for thrusting between and under stones and pebbles.

The flexibility of the upper mandible derived from the long grooves and flattened form (extending to nearly half its length), tends materially to assist the bird in fitting its curved bill close to a stone, and thus aids it in searching or fossicking around or beneath the shingle for its food, while at the same time the closed mandibles would form a tube through which water and insects could be drawn up, as water is sucked up by a syringe. As the flexure of the bill is lateral, the bird is enabled to follow up retreating insects, by making the circuit of a waterworn stone with far greater ease than if it had been furnished with the straight beak of the plover, or the long flexible scoop of the avocet.

The inspection of these specimens must clear away any little cloud of doubt that might remain on the minds of persons unfamiliar with the bird, and convince them that this singular form of bill, so far from being an accidental deformity, is a beautiful provision of Nature, which confers on a plover-like bird the advantage of being able to secure a share of its food from sources whence it would be otherwise unattainable.

October 14.—Since the above paper was written, an opportunity has been sought of visiting a favourite habitat of the *Anarhynchus*, as an examination of the head of the bird was desirable.

The mandibles are connected by a membrane, fringed with a tough black border, forming itself, when the beak is closed, into a slightly projecting fold at the gape; the upper mandible (or roof of the mouth) is armed with a treble row of very fine spines, set like the teeth of a saw, pointing to the base of the mandible; the tongue, when at rest, lies well within the lower mandible, it is partly sulcate in form, tapers to a very fine point, is much shorter than the beak, leaving a vacant space of six lines from its extremity to the end of the lower mandible; the base is furnished on either side with a few spines (three or four), planted in the same direction as those in the roof of the upper mandible; the thick portion of the tongue is indented with four or five very slight longitudinal furrows, terminating in the channel into which the tongue now resolves itself till it ends at the very acute point; this sulcate form is attained by the edges being raised.

From this peculiar form of tongue, it may be observed that no hindrance is presented by that organ to the sucking up of water; the spines would prevent the escape of the most slippery or minute prey, which could be crushed by the closing of the beak and the pressure of the tongue against the upper mandible, the water finding ready egress.

The tongue of *C. bicinctus* is altogether different in form.

No. 74.—Ardea sacra, Gml.
Matuku.
Blue Crane.

With us in the South, this bird is of rare occurrence; occasionally it may be observed on the flats at the head of one of the bays; as yet, we only look upon it as a visitor. When we have noticed it on the wing it has been flying low, just skirting the shore, with deliberate, almost heavy, flight. Last year, an egg was received at the Canterbury Museum which had been taken from a nest in Hawke's Bay. In colour it is greenish white, ovoiconical, measuring 1 inch 10½ lines in length, with a breadth of 1 inch 4 lines.

No. B. 75.—Ardetta pusilla, Gould, (Botaurus minutus, Haast.)
Kaoriki.
Little Bittern.

Some of the scientific institutions have lately been favoured by Mr. Purdie, the Curator of the Otago Museum, with photographs and descriptions of an exceedingly rare and interesting species of bird belonging to the Grallatorial division, and which may be taken as the Australian representative of the Little Bittern of Europe. The rare occurrence of this bird, of which only three other

specimens, as far as can be ascertained, have been obtained in this country, is remarkable, when it is considered how great an extent of country, formerly almost entirely unknown, has been opened up and explored by enterprising colonists during the last ten years. In March, 1868, Mr. Shaw, of Kanieri, one of the Wardens on the West Coast, presented two specimens to the Canterbury Museum, which were stated to have been obtained whilst feeding near a deep, slowly-flowing, swampy watercourse, by the River Kanieri, and at no great distance from the township of that name. From having been obtained at the same time and place, they were supposed to have been a pair, but it appears that no examination was made before the preparation of the skins; they bear a close resemblance to the description in Gould's *Handbook to the Birds of Australia* of the male *Ardetta pusilla*, and are probably both young males. Subsequently, another specimen of a young bird of this species was obtained in one of the swampy creeks that feed the Okarita lagoon, and was forwarded from the Canterbury Museum to Dr. Otto Finsch, of Bremen.

The following description is taken from the larger of the two specimens in the Canterbury Museum:—Beak long, higher than broad, almost straight, having but a slight curvature towards the point, measuring from gape to tip 2 inches 9 lines; upper mandible flattened on the top, near the base, slightly channeled, nostrils pierced in the groove, defended with membranous process; legs long, gartered or bare above the tarsal joint for 8 lines; tarsus 2 inches 1 line; three toes in front, each furnished with membranous fringe on the inner side, two outer toes united with narrow web extending to first joint; middle toe with claw 2 inches 3 lines; middle claw toothed on the inner side; one toe behind, directed inwards, more robust than those in front, with curved produced claw; toe measuring, with claw, 1 inch 4 lines, of which claw measures 6 lines; wings slightly concave, 6 inches 2 lines, first feather rather shorter than second and third, which are the longest in the wing; total length from tip of beak to extremity of tail 14 inches; under part of lower mandible, sides of bill palish yellow, almost white; edge of mandibles brown; culmen almost black; top of the head greenish black; outer edge shot with bluish black, with a few brown feathers receding from forehead; feathers on the throat and lower part of the neck pale buff with brown streaks; side of neck deep chestnut brown, a narrow stripe of the same colour over the eye; scapularies and back dark brown; wing coverts buffy brown, with deep chestnut on the shoulder, a few of the feathers striped down the shaft with black; edge of the wings coloured with rich brown shaded; primaries dull black; thighs pale buff with streaks of dark brown, darkest behind; tail greenish black.

It is stated that the Little Bittern is so quiet in its habits that it will remain still when approached, so that it will apparently almost suffer itself to be taken by the hand. The birds just described were taken alive, it has been

said, without any very great difficulty; after which they were turned loose amongst the fowls in a poultry-yard. They were found dead shortly afterwards, it is alleged, from exposure to the keen frosty night air, being deprived of the accustomed protection afforded by the thickly-growing sedgy vegetation of their swampy habitat. They had been observed standing motionless on a bare stem or stalk, from which they overlooked the water.

From the description given of our bird, it will be observed how much it differs in the general coloration of its plumage from its antipodean representative (*Botaurus minutus*), which has the top of the head, shoulders, primaries, and tail bluish black, whilst the rest of its plumage is buff, except the front part of the neck and chin, which are whitish, as is also the vent; the size must be about the same, as we have noted measurements of specimens which are less than those of our Bittern, as well as some which exceed them; both have the middle claw toothed on the inside, irides of *B. minutus* are said to be yellow; the fact that the feathers on the tibiæ are said to reach the tarsal joints, points out pretty clearly that the New Zealand wader is the more aquatic of the two species.

Having been entrusted by Dr. Hector with a copy of the photograph and the description of Mr. Purdie's bird (which he proposes to name provisionally, *Ardeola Novæ Zelandiæ*) for comparison with the Little Bitterns preserved in the ornithological collection in the Canterbury Museum, after careful examination I am unable to discover any material difference between them and the specimen from Otago. In Mr. Purdie's description, the under parts and thighs are described as brown with greyish white margins, and the photograph exhibits the hind claw rather more produced, but there can be no doubt, I think, that these birds are of identically the same species. Mr. Purdie notes the legs and bill of his bird as yellowish green, eyes rufous brown.

October, 1870.—The Canterbury Museum received two fine specimens from Westland, lighter in colour, without the rich deep chestnut markings on the side of the neck, etc., which are conspicuous on the birds obtained in 1868; this *may* be the distinction of the sexes; no information on that point accompanied the skins; or it may be the difference of plumage between the seasons of spring and autumn.

Any information respecting the habits of the Little Bittern would be exceedingly interesting; judging from the natural features of the localities whence the Westland specimens were procured, it would appear to live on the sedgy margins of deep swampy pools or creeks.

Mr. Docherty, who preserved the skins now in the Christchurch Museum, furnished the following Notes, descriptive of where they were obtained:—"They are to be found on the salt-water lagoons on the sea shore, always hugging the timbered side of the same; I have seen them in two positions, viz., standing on the bank of the lagoon, with their heads bent forward, studiously watching the water; at other times I have seen them standing

straight up, almost perpendicular—I should say this is the proper position for the bird to be placed in when stuffed. When speaking of lagoons as the places where they are to be found, I may mention that I caught one about two miles in the bush, on the bank of a creek, but the creek led to a lagoon. They live on small fishes or the roots of reeds; I should say the latter, because at the very place where I caught one, I observed the reeds turned up and the roots gone; they are very solitary, and always found alone, and stand for hours in one place. I heard a person say that he had opened one and found a large egg in it. They breed on the ground, in very obscure places, and are, on the whole, a rare bird. I never heard their cry."

The fact that the Little Bittern was noticed by Mr. Ellman, in 1861, was overlooked when this paper was written. Mr. G. R. Gray, in his "List of the Birds of New Zealand and the Adjacent Islands," p. 24, puts this query,— "What is the Little Bittern, Ellman, *Zool.*, 1861, p. 7469?"

In plumage, our Little Bittern of the West Coast rather resembles the American wader (*Ardea virescens*) than the Little Bittern of Europe.

No. 87.—Ocydromus australis, Sparrm.

(See also Vol. ii., p. 70.)

The history of the Weka, the Wood-hen of the settlers, is not yet complete; there exist varieties which are marked, although ornithologists might object to class them as distinct species.

Whilst camping in one of the gorges of the Rangitata, a very striking variety used to visit the tent constantly; the individuals of either sex were above the average size; the general colour of the plumage light greyish brown; the feathers marked or barred with shades of dark brown; the uropygium and in some instances the tips of the primaries rich chestnut; throat and cheeks grey. The young were dark brown, perhaps not to be distinguished readily, if at all, from the young of the ordinary brown Weka (*O. australis*).

Some months since, a specimen with the entire plumage of pure white, was caught alive at Mt. Four Peaks; the legs and bill pale red; irides reddish brown;—not the light pink that is characteristic of the albino.

One of the best walkers amongst our birds, the Weka's step is usually deliberate and slow; its carriage is particularly noticeable, it is so remarkably bold and confident, yet wary; the neck raised, with the head carried forward with a listening and yet contemplative air, one is loth to believe that the bird is such a mischievous rogue. When at full speed, the neck is extended, the head lowered, with the point of the beak slightly depressed; if pursued, it turns and doubles rapidly, availing itself of any shelter in which to find refuge. It regains confidence quite as readily as it exhibits fear, and if left in peace, emerges from its place of concealment with the same coolness of demeanour that usually distinguishes it. We have caught a whole family of

old and young; after being released, they started off, but returned soon afterwards with their ordinary air of inquisitiveness. When two males quarrel, they fight with determination, sometimes coming out into the open ground; the victor becomes a relentless persecutor, driving off his antagonist at every opportunity; on these occasions one can appreciate the speed and alertness which both pursuer and pursued display, in getting over the ground and threading the interlaced maze of shrubs and grassy tussocks.

The nest figured (see Plate VII.) is placed amongst the sheltering leaves of snow-grass tussocks, in which the roughly-finished home of the Weka is frequently constructed.

The colour of the down of the young affords a fair indication of their age, the darker shades of brown characterizing extreme youth, yet the lighter shades which their plumage gradually assumes offers great variety. Such is our experience after quietly looking at some scores of broods; there is in their early stage of growth a resemblance to the Cochin China chick about them, this would be stronger but for their smooth tarsi and dusky hue; perhaps this idea is due to the absence of even an apology for a tail, for the caudal plumage is not assumed until half their growth is reached, but whilst they are still under the guidance of the parent birds. Whilst being led forth food hunting, the brood is most sedulously attended by the old birds, although perhaps they may not be at one time both close together; insects, worms, lizards, etc., seem their principal food, yet nothing comes amiss to these omnivoræ. When an old bird is aware of a lizard lying *perdu* beneath the sharp pointed leaves of an *Aciphylla*, the beak is thrust into the plant in defiance of threatened wounds, the wings are suddenly thrust forward, and the adroit Weka backs out with her writhing prey, which the young instantly devour.

Although mercilessly persecuted, this Ishmael amongst birds may be found or heard in most up-country districts, but in greatly diminished numbers. The size of the Wekas that are now usually met with, is much smaller than it used to be; a four-pound bird is now almost unknown, yet, years ago, such a weight was not an uncommon one for a fine hill bird. The greatest sin we can lay to its charge, is the ruthless manner with which it destroys ducks' eggs, in which it is second only to the harrier.

The Weka sometimes, yet rarely, has been noticed to have a white feather or two in the wing.

As an article of food, it is in far less repute than when we first settled here in the days of dear meat;—(we have since bought sheep at one shilling per head) —our taste is more fastidious, and the Weka is only killed too often for mere wantonness, or the *pleasure of taking life*. The Maoris of Arowhenua make expeditions in the winter for obtaining a supply of these birds, which they preserve in their own fat. On one run, near Burke's Pass, we have been told that above two thousand wekas were secured by a party of natives at one of these hunts.

No. 91.—Porphyrio melanotus, Temm.

(See also Vol. ii., p. 71.)

The nest which is figured on Plate X. was procured from the swamp by Lake Ellesmere; it was firmly built of the leaves of a *Carex*, and formed a compact mass, some eight inches in height, not very easily to be distinguished, as the material of the nest was as green as the surrounding grasses. The eggs are often sucked by the harrier, whose keen sight discovers the very inartificial structure of the Pukeko, on examining a nest after a harrier's visit, we have observed that the contents of the egg have been extracted through a long hole made at the bilge of the egg. Few birds more frequently become the prey of the harrier than this wader.

No. 95.—Spatula variegata, Gould.
Shovelor.

One of the handsomest and perhaps also one of the least known amongst our group of *Anatidæ* is the Shovelor; the variegated plumage, dark ruddy breast, and bright blue wing of the drake, exhibit one of those instances—as in the case of the mallard, at home—in which nature, for its own special reasons, lavishes much beauty of colour on the male, whilst the female is clothed with feathers of a far less attractive hue. In the case of the Shovelor, may not this remarkable distinction in the plumage of the sexes be regarded as a protection for the eggs during the period of incubation, rendering the female less liable to observation than if she was arrayed with brighter colours, with which she could scarcely elude the keen vision of the harriers, the most successful of egg-robbers. A habit of this duck would appear confirmatory of this view; we have repeatedly noticed in the breeding season that the groups of Shovelors which dot the lakes, here and there, are nearly all drakes, a fact that indicates that the male bird has little, if anything, to do with the nest or the labour of incubation. It is very generally distributed over the country, although large numbers are only to be met with in certain localities in the North Island, where it is in some parts, or has been, of common occurrence; for, in the season, numbers were to be seen hanging up in the poulterers' shops in Wellington, which had been brought to that market by the steamers from Hawke's Bay; we say *has been*, as the supply appears to have failed; for the past two winters we have certainly missed the Shovelors.

For some years after settling here, we regarded this bird as quite a *rara avis*, we observed it so very seldom, and then only in the neighbourhood of the Rakaia; it is now much oftener met with than was formerly the case. On the wide expanse of Lake Ellesmere, and the less extensive mountain lakes in the Ashburton country, it is frequently seen in considerable numbers; occasionally specimens have been obtained near Christchurch.

Nest of PORPHYRIO MELANOTUS

See Vol. II Page 71

J. B. lith. | by J. Earle.

For years we hunted unsuccessfully for the nest, trying the most likely swamps in the neighbourhood of its haunts, in the hope of making the discovery, but our diligent quests were in vain; one of the writer's sons was at last successful, as the following communication will show:—"Hurrah for the Shovelors! Yesterday (Nov. 7), we found a nest at last; it was placed not in a swamp, or even near water, but on the side of one of the low downs in Craig Phillips (near the Rangitata), sheltered by a couple of tufts of tussock and a plant of Spaniard grass (*Aciphylla*); it was made of fine grass, in which was a fair amount of down, but not so much as is usually seen in the nest of the grey duck (*A. superciliosa*); it is deep, and rather narrow across the top (about 7 inches); the eggs, ten in number, ovoiconical in form, very smooth and fine in texture, creamy white with a slight greenish tint, measure in length 2 inches 1½ lines, with a breadth of 1 inch 5½ lines."

This nest was probably commenced in the first week of October, as some of the eggs placed under a hen were hatched on Nov. 18. The young bird greatly resembles young grey duck in colour, being clouded with brown and yellow, but the peculiar form of the bill, with its broad point, is noticeable when it emerges from the shell.

The singular shaped bill, which gives a name to this duck, is well worth studying; it is nearly three inches in length, much dilated near the extremity, the upper mandible possessing great flexibility, is abundantly furnished with nerves, conferring a great degree of sensibility on that organ, which must greatly aid the bird in selecting its food; it terminates in blunt unguis of considerable hardness. Both mandibles are furnished with a pectinated appendage, in which laminæ are closely arrayed, the sharp and projecting teeth of the upper mandible overlapping and acting against the peculiar apparatus of the lower mandible. From this elaborately-organized trap, even the smallest aquatic insects could not escape.

No. 98.—Hymenolaimus malacorhynchus, Gml.

Whio.

Blue Duck, Mountain Duck.

(See also Vol. ii., p. 73.)

Having stated that the Blue Duck occasionally breeds in holes of banks, it is worth recording, perhaps, that we found the nest in situations that did not afford any great amount of shelter; one of these instances was met with on a spit in the Upper Ashburton River, about three miles below the glacier from whence that river derives its source; the nest was placed in a solitary snow-grass tussock of moderate size, within two or three yards of the stream: it was made of grasses, the interior composed of cut grass like chaff, down, and a few feathers.

In examining an embryo of three weeks, we found that the form of the

bill was well developed, showing on the sides, near the end of the upper mandible, the peculiar membranous appendage of a darker colour than the rest of the bill, but were unable to discern the presence of lamillæ; the caudal down was produced to a marked degree.

When hatched, the young are large compared with those of *Fuligula Novæ Zelandiæ*, measuring 7 inches in total length, of this nearly one-third is contributed by the tail; bill from gape 9 lines.

Bill horn colour, lightest on the lower mandible, unguis rosy at the point; membranous appendage slaty black, well overlapping the lower mandible, furnished with lamellæ along its basal half, which work against the finely serrated sides of the compressed basal half of the lower mandible; upper surface dull green, brightest on the back; over and behind the eye irregular streak of white; under surface white; wings and upper part of thighs brownish; tail green above, at each side a patch of chestnut; under surface of the tail chestnut, covered with thick down, longest on the back; legs and feet yellowish flesh colour.

As will be seen from the above description, the Mountain or Blue Duck in its earliest stages of growth is very prettily marked, with its green and white down, relieved by patches of chestnut; it differs much from the young of any other native species of *Anatidæ* with which we are acquainted; the tail is much produced, in swimming it is carried well above the water. When the parent birds have their brood in charge, they certainly exhibit much less craft as well as energy for the protection of their offspring than any other duck; with them there is little, if any, attempt at concealment of the young, none of the ruses are made use of, which, with the paradise ducks, often prove so successful in misleading their enemies; usually, they simply drop down the rapid, trusting apparently for escape to the turbulence of the stream—an asylum safe enough from most, if not all, indigenous persecutors, but not from the settler's dog; they seem loth to land, and if compelled to do so, their progress is not very rapid, in fact, they impress one with an idea of their helplessness. The duck marches in front, with her low wailing call, the small brood follow, whilst the drake protects the rear, or rather offers himself as the first victim to the pursuer.

For the last two years we have seen fewer Mountain Ducks than usual; if anything can save them from utter extermination it will be the remoteness of their haunts. Protective enactments have doubtless proved beneficial in restraining the unscrupulous in many cases, but such laws would probably be better observed if better known, for when one observes a string of ducks hanging up at a house in *December*, it must surely arise from ignorance of our legislative enactments that such an outward and visible sign of their infringement is made patent. In winter time they congregate in flocks of moderate numbers.

Before leaving these Notes on the Blue Duck, there is one peculiar habit that might be noticed, it is the manner in which it can turn in the water; however rapid the stream, it can turn instantly, as though worked on a pivot; doubtless the produced tail gives this facility. When it is quietly fossicking amongst the soft banks of the mountain stream, it may be seen indulging this habit, without apparently losing an inch of space.

No. 99.—PODICEPS RUFIPECTUS, Gray.

Little Grebe, Red-breasted Grebe, Dab-chick.

(See also Vol. ii., p. 73.)

Few, if any, of our aquatic birds display more restless activity than the Red-breasted Grebe; this quality is exhibited in a variety of ways; look at the enquiring jerky manner in which the head and neck are carried, slightly in advance, yet continually moving from side to side; a habit that may result from the mode in which its food is obtained. When diving and searching for its prey, the head is doubtless moved from side to side, in order to scan as much of its watery track as possible before returning to the surface; by this restless air the bird seems perpetually on the watch for a surprise, yet it displays a frequent boldness in gratifying its curiosity that is seldom, if ever, shown by many water birds. Then, in watching its progress when swimming, its action appears fitful rather than regular; should any unusual object excite its curiosity or suspicion, it advances towards it with a regular zigzag approach. Its diving power is admirable; how easily and gracefully it is effected—the head by a rapid motion is lowered, and in smooth water a few air bubbles rising to the surface alone denote the spot from whence it disappeared. The length of time it can remain submerged is astonishing, and this, too, we have observed in a swift eddying stream at the confluence of two large creeks. We have ever thought it a pretty sight to watch a family of Grebes on some lonely tarn or pool, fringed by a narrow but dense belt of *Discaria* or *Olearia*, that afforded an efficient screen for observation.

We never saw more than two young ones in a brood; very often the labour of the parents is most equally shared, by each appearing to take charge of a young bird, which float about quietly, often with the neck bent back, the head resting between the shoulders, now and then uttering a soft trilling note not unlike, but less marked, than the call of the parent birds.

The old Grebes dive incessantly, remaining but a very short time under water; when their effort has been successful, a soft call summons the young bird, and the aquatic morsel, whether fish or insect, is always dipped in the water before it is offered to the young one. In the brief intervals between the dives, the wings are carried high, somewhat swan fashion, as if the more readily to catch the drying influence of the air. For some weeks the young preserve a greyish tone of plumage over the upper surface, the head retains some light greyish down, whilst the breast is pale rufous.

The figure (Plate VIII.) represents a nest built against one of those large black stems of *Carex virgata*, which so often dot the shallows of some of the inland lakes; it is constructed of aquatic plants and roots, is screened by the long sweeping leaves of the *Carex*, which hang over till the points of the leaves dip the water. It is only by wading and very close search that these nests are to be discovered. We have not, as yet, remarked that the bird covers the eggs on leaving the nest; this is a habit which many writers attribute to the Grebes of Europe.

We have not seen the Grebe on land, and seldom flying; when on the wing it just skims the surface of the water, with a very rapid motion of the wings. On one occasion we noted several in company, on a lake of moderate size, making use of their wings.

B. 131.—STERNA (ALBA, sp. nov. ? Potts).
White Tern.

In Gray's "List of the Birds of New Zealand and the Adjacent Islands," may be found,—*Gygis candida*, Wagl. White Tern, Lath. *Sterna alba*, Gmel. *Sterna candida*, Gmel. Habitat, Norfolk Island.

Now, whether the bird we have lately seen is identical with that in the above list, we cannot undertake to decide, and briefly record the occurrence of a White Tern, under conditions presumptive of its breeding here.

On the 4th of January, whilst crossing "the plains," from the Rangitata to the Rakaia, amongst a large number of the common tern (*S. antarctica*), wheeling and hovering about one of the streams of the Ashburton, we first observed this white bird. The shingly river-bed about this spot had been selected as a breeding place by the common tern, for, crossing it about five weeks previously, we had noticed many of their dusky-coloured eggs lying in couplets on the bare gravel.

On sighting the White Tern, we left our horses to graze on the soft grass that fringed a rippling creek, and watched its movements with great interest; the orange-billed *S. antarctica*, vociferous and bold, flew screaming, with rapid darts, close enough to be reached with a riding-rod, marking their irritation at our intrusion by swooping close to our faces, sometimes ejecting a whitish fluid on us; the stranger, less confident, kept rather aloof, with a different style of flight to that of its congeners, less rapid, but not to our thinking did this arise from any lack of power; the wings appeared more bent, the stroke more deliberate. As we watched its devious course up and down the stream, its pure white plumage was easily followed; sometimes it skimmed over the surface of the swiftly flowing river, or hung hovering for a few moments a few feet above, now and then rising to a considerable height, often to an elevation only reached by a few of its busy companions. Several times it was observed to settle on the shingle, soon rising again, wheeling about with renewed activity. As the tern's breeding season, in this country, may be considered at its height

at this time, we should be inclined to think that the stranger was nesting here.

The entire plumage was white, upper, lower surface, and *head* also; the bill appeared to be light coloured. Our observations were made chiefly during its rapid movements, so that of the bill, tarsi, and feet, we cannot pretend to give a reliable description.

No. 134.—Phalacrocorax (Graculus) carbo, Linn.
Kauau tuawhenua.
Great Shag, Cormorant.

This large species of our native *Pelicanidæ* must enjoy a most extensive range, as there appears to be not much doubt of its identity with the European cormorant which is met with in the highest latitudes of the northern hemisphere; it would seem that it was formerly known sometimes as the sea-raven or crow, from its rapacity. It is worth recalling, that our eldest poet, that great student of nature, mentions these birds together in two consecutive lines,—

"The hote *cormèraunt*, full of glotonie
The *ravin* wise, the *crowe* with voice of care."

This fine-looking bird, one of the most industrious of fishers, appears to be generally distributed throughout the country; unlike *G. punctatus*, *G. brevirostris*, and others, it is of rather solitary habits, whereas those species delight in the association of numbers, their rapid motions imparting an air of liveliness and gaiety to the rocky wave-worn coast line, or the placid waters of the deep inland lake. It is usually classed as a sea bird, yet, although it frequents our coasts and harbours, it is to be observed a great way inland, and, taking the width of the island into consideration, a very long distance from the sea; we have noticed it to the west of Lake Coleridge. Except during the breeding season, it may be said to pass rather a solitary life; its favourite post, where obtainable, is the outstretched limb of some blasted tree on the verge of the bush, or a ledge of rock near to a stream or lake; but although thus solitary, it is by no means to be considered shy or timid; it does not "fly the haunts of men." We have often observed it perched on the lofty chimneys of the public buildings in Christchurch; two years since a mass of its nesting materials was cleared away from some part of the roof.

This ruthless desecration of the lares and penates did not cause the abandonment of the settlement; with the clear sparkling Avon flowing immediately below, the situation was too good a one to be forsaken without the display of more active hostilities. These favourite posts still continue to be frequently occupied, notwithstanding that birds are sometimes shot there, for the protection of the young trout, with the acclimatization of which our silent fisher unwisely interferes.

Its flight occasionally is very lofty, seldom very straight; from watching

its progress whilst soaring or wheeling aloft, one might imagine it to be trying "great circle sailing;" it approaches and glides to its perch with sweeping curves rather than by a direct course; its appearance is the signal for alarm amongst all poultry within reasonable distance, yet it is harmless and peaceable except where fish are to be found. After much occupation on or in the water, it has a knack of drying its feathers in a peculiar manner, which gives it a most grotesque appearance; it stands, say on a sunlit rock, stretching out its quivering wings horizontally, till it really looks not at all unlike the old-fashioned sign of the "spread eagle."

Its activity in the pursuit of its finny prey is indeed remarkable, and, as is well known, in some countries led to the taming of the bird for the purpose of rendering this dexterity of service to man; one of the old offices in the royal household of England was that of Master of the Cormorants.

Its breeding station sometimes is shared by others of the species, whose nests are built in pretty close proximity; sticks, partially decayed leaves of *Phormium*, and coarse grasses, furnish the materials of these structures, which yield from the accumulated filth, a powerful and disagreeable odour. The eggs, at most four in number, are long ovoiconical in shape; they are greenish white, covered with chalky incrustations; they measure 2 inches 5 lines in length, and 1 inch 6 lines in breadth. The young birds remain in the nest till they have attained a considerable size.

In the neighbourhood of Christchurch, not very far from the sea, is, or rather was, a swamp of considerable extent, which was selected some years since as a breeding station by certain species of our numerous family of the *Graculidæ*. Numbers of birds were attracted to the spot; a visit to this nursery ground showed them in multitudes, arriving, departing, or stationed in quaint attitudes about the huge tufty heads of the pendant-leaved *Carex*. It was noticeable that the tops of the Maori-heads were almost invariably occupied by the large coarsely-built homes of *G. carbo;* beneath, against the dark tufted root-stems, the less ambitious little river shags reared their offspring. Unsavoury odours, of a most penetrating kind, pervaded this colony and its neighbourhood, from the great accumulation of slimy exuviæ; one could conceive that it was possible for the sea-washed rock to be changed into the guano island—it would be simply a sum in multiplication worked out by Time. Without staying to moralize on the fact that the same great Chemist transmuted the poison stench of one age into a commercial item which has afforded employment to thousands of human beings in another, we may mention that our little colony was not without its value, outside of its purpose for bird incubation.

As the explorer somewhat carefully picked his way, his advancing footsteps shaking the trembling morass, eels of the largest size disturbed were observed threading the watery mazes of the quaking bog, their bulk and condition

proofs that the bird colony furnished them with abundance of fattening food. The following year this locality was abandoned by the shags, who established themselves on a swamp by the Purakanui; this likewise was deserted at the next breeding season. Why? If this change of quarters was rendered necessary by the presence of vermin or filth, how is the guano island built up, unless, indeed, the salt breezes of the ocean befriend the birds by destroying their parasitic tormentors.

ART. XII.—*Notes on an Egg of* Alca impennis, *Linn., in the Collection of the writer.* By T. H. POTTS.

[*Read before the Wellington Philosophical Society, July* 16, 1870.]

ALCA IMPENNIS, Linn.; Great Auk, or Gare-fowl; the Geir fugl of the Icelanders;—is the rarest of the *Alcidæ,* and probably also, it is the rarest bird of the northern hemisphere.

Various authors have described it as living, except during the breeding season, almost habitually at sea, where its wondrous powers of swimming and diving procured for it a constant supply of food; we know from good authority that formerly it was to be found at St. Kilda, the Orkney and Faröe Islands, Iceland, etc., but however numerous the flocks then met with, in various parts of the stormy northern seas or its rocky ice-bound shores the Gare-fowl rapidly became scarce. Perhaps its numbers were diminished to satisfy the craving appetites of half-frozen whalers and sealers, whose visits too would most probably take place during the breeding season, when the brief summer opened up a track for the vessels through boisterous seas, haunted with floating icebergs. I think Henry Hudson, the old navigator of those inclement seas, intended the Gare-fowl when he wrote:—"They killed and brought with them a *great* fowle, whereof there were many and *likewise some eggs.*" There was evidently no *close time or fence month* observed for the Great Auk; bird and egg was equally welcome to those "toilers of the sea."

So rare at last became this sea-fowl, that the only specimen the British Museum possessed for many years, was the bird obtained by Mr. Bullock, and which was purchased at his sale, May, 1819. The curious naturalist will find in the catalogue of that great sale of zoological curiosities:—"Lot 43; Great Auk (*Alca impennis*), a very fine specimen of this exceedingly rare bird, killed at Papa Westra, in the Orkneys, the only one taken on the British coast for many years," etc.

So long a period has elapsed since a living specimen has been observed, that many naturalists, amongst them Professor Owen, are inclined to regard its extinction as an accomplished fact, for, notwithstanding the scientific explorations, more or less exhaustive, which have characterized the various Arctic expeditions, not a single instance of the occurrence of the Gare-fowl is recorded.

From notes and observations of various travellers, sportsmen, and collectors,

who have been led to visit the high latitudes of Iceland and other places, we believe that the Gare-fowl still exists and breeds on some of the surf-beaten Skärs and Skerries, where a frightful surge almost perpetually rages, and denies access to the boldest explorer. (Would that some of *our rarer* birds could be sheltered from impending extinction by a barrier as secure, and thus be saved from the destructive attacks of the mercenary plunderer.)

The author of *Ten Years in Sweden*, writes:—"I do not believe this bird is extinct, although not one has been seen or an egg taken for several years. The value of this bird is as well known in the North as in England."

So highly is an example of this bird esteemed in collections, that in Wood's *Natural History of Birds*, a list is given of all those specimens of the bird or egg which are known to exist in the various museums, and public and private collections, throughout Europe and America, recording the number of specimens which each country possesses.

Baring Gould, in his *Iceland, its Scenes and Sagas*, who contributes a fund of valuable information as to the probable habitat of the Gare-fowl, makes the total number larger than that given by the Rev. J. G. Wood.

For several years I could boast of having three of the eggs in my possession; Dr. Meyer, the author of *British Birds and their Eggs*, inspected and made notes of these ornithological treasures. When, in 1853, I parted with some portion of my collections, one of these rare eggs was purchased at public auction for £30. This was commented on by some of the serials of that date as an extraordinary fact.

The egg which the drawing exhibited is intended to represent, and the smallest of the three mentioned above, measures in length 4 inches 8 lines, by 2 inches 10½ lines in breadth; it is white, slightly soiled in two or three places with dull yellow, marked and oddly streaked, principally at the larger end, with black and blackish brown.

Some twenty years ago very excellent imitations of the Auk's egg were manufactured in France; they were intended to fill up the place of the real egg in the cabinets of oologists; some of these specimens soon crossed the English Channel, and attempts were made to pass them off as genuine. I well remember the pleasure with which a communication was received from a leading naturalist and dealer, that he was at length in possession of some eggs of the Great Auk; on examining these so-called eggs, I was at once struck with their weight, absence of pores, and the extraordinary fact that all were alike, mark for mark; on placing one of my own specimens before my correspondent, he saw at once that he had been gulled, and admitted that he had been cheated out of £18 for half-a-dozen specimens in plaster-of-paris; he, however, fell back on the doubtful consolation that he was not the only sufferer, for, according to a police report of a charge of obtaining money under false pretences, a brother naturalist had been similarly cajoled.

ART. XIII.—*On the Nests and Eggs of some Species of New Zealand Birds not previously described.* By Captain F. W. HUTTON, F.G.S.

[*Read before the Auckland Institute, July* 11, 1870.]

DURING the summer of 1867-8, Mr. Kirk and myself, while exploring the Great and Little Barrier Islands, found the nests and eggs of some species of birds which do not appear to have been noticed by Mr. Potts. I have therefore written a short description of them as an appendix to his paper of last year.

CREADION CARUNCULATUS, Gml.

One afternoon, at the end of December, on returning to our camp on the Little Barrier, we observed a Saddle-back fly out of the hollow top of a dead tree-fern stem, and on examination we found the nest about two feet down it. It was roughly composed of stems of *Hymenophyllum*, and the dead fibres of the nikau (*Areca sapida*), and lined with the fine loose bark of the tea-tree (*Leptospermum*). It contained three eggs of ovoid form, and of a bluish white colour, spotted with brownish grey and violet, the spots being closer together near the thick end of the egg. The length of the eggs was 1 inch 2 lines. They had not been sat upon.

This furnishes another proof of the well known fact, that the colouring of the plumage of those birds that build in holes is identical, or nearly identical, in both sexes.

RALLUS PECTORALIS, Less.

The Land-rail builds on the ground, generally under a tussock. The nest is loosely composed of grass, etc. The egg is ovoid in shape, and of a pinkish white or cream colour. It is spotted, principally at the larger end, with spots and blotches of two colours, one a reddish chestnut, and the other more of a grey, looking as if the chestnut spots had been washed out or covered with a semi-transparent covering. Length 1·5 inch, greatest breadth 1·2 inch.

MAJAQUEUS PARKINSONI = *Procellaria Parkinsoni*, Gray.

We also found on the Little Barrier, at an altitude of 1500 feet and more above the sea, several specimens of this bird sitting upon their nests, but only one nest had an egg in it. This bird breeds in holes under the roots of trees. The entrance to the hole is irregular in shape, but generally just large enough to admit the hand. Some of the holes were three feet long, and each was enlarged at the end where the bird was sitting with its beak turned towards the entrance, and in this enlarged space some dried leaves were placed. The

holes were not in the cliffs, nor even near them, but in the midst of dense bush so thick with supple-jack (*Rhipogonum scandens*), and manga-manga (*Lygodium articulatum*), that we found considerable difficulty in forcing our way through it, and it is difficult to imagine how the bird could possibly make its way out to sea, and back again to its nest.

The single egg we found had been slightly sat upon ; it was ovoid in form, white and shining. Length 2 inches 10 lines, and greatest breadth 2 inches.

GRACULUS VARIUS, Gml.

At Port Fitzroy, in the Great Barrier, we found a colony breeding in nests built in trees hanging over the sea. The nests contained two eggs, of a light blue colour and chalky texture, and of oval form ; length 2 inches 5 lines, breadth 1 inch 6 lines. They had not been sat upon on the 16th November.

SULA SERRATOR, Banks.

This bird breeds in considerable quantities at Mahuke, a small island lying off the Great Barrier. The point of land of which they have taken possession juts out into the sea, and is about 150 feet above the level of high water ; it is quite bare of vegetation at the top, and so covered with nests that it was not easy to walk about without treading on them—in a space of 18 yards by 7 yards we counted 150 ; the nests were mounds of earth, about 22 inches in diameter at the bottom, about 4 inches high, and about 14 inches at the top. On the top of each was a slight hollow, 5 inches in diameter, and in this hollow sometimes, but not always, a little seaweed (*Macrocystis pyrifera*) was placed. On the 7th December, some of the nests contained fresh eggs, some eggs that had been sat upon, and some young birds ; most of the nests had one egg or bird in it, but a few had two. It is hardly necessary to add that the smell was very offensive. The eggs were white, but often stained brown with dirt, oval in form, and chalky ; they were often cut and bruised, probably by the beak of the old bird when moving them. The freshly-hatched birds are of a slate colour, but get gradually covered with white down.

The old birds walk on land with difficulty, and on alighting fall down with considerable force on their breasts ; when rising from the sea they strike the water with both feet together, as do all the cormorants ; unlike the petrels, which strike with each foot alternately. Neither are they very active in rising from the land, as we proved by rushing in on them from a distance of fifteen or twenty yards, and seizing them before they could get off their nests.

They appear to be incapable of closing the eyes.

N.B.—The eggs of all these birds may be seen in the Museum of the Auckland Institute.

Art. XIV. — *Notes on the Habits of* Podiceps cristatus.

By W. T. L. Travers, F.L.S.

[*Read before the Wellington Philosophical Society, June* 25, 1870.]

Amongst the birds which frequent the inland lakes of the Middle Island are two species of Grebe, namely, the *Podiceps cristatus,* or Crested Grebe, and the *Podiceps minor*, or Dab-chick. It is only of late years that ornithologists have cleared up the confusion in which the classification of the birds of this family was left by earlier writers, who had fallen into perhaps pardonable errors, in consequence of the great changes of plumage which they exhibit at various ages and seasons, many of the more beautiful and apparently distinctive features being now found to exist only during the breeding season. It was, indeed, for some time matter of controversy between Mr. Walter Buller, one of our chief authorities on the ornithology of New Zealand, and Professor Finsch, of Vienna, whether the Grebe named by the former "*Podiceps Hectori,*" in honour of Dr. Hector, was or was not identical with the European *Podiceps cristatus*; and it was not until Mr. Buller had, under the light of the learned professor's suggestion, examined an extended suite of specimens, that he felt himself justified in concurring in the latter's conclusions in reference to this matter. He still, however, expresses a belief that we have, in this country, a distinct species of Crested Grebe, distinguishable from *Podiceps cristatus* by a permanent difference in the colour of the under parts of the body, but whether this distinction will be maintained after a full investigation, I am unable to decide. Until Mr. Buller's proposed distinction has been established, however, I must treat all the birds observed by me as belonging to the one species.

Podiceps cristatus is found at all seasons of the year upon Lake Guyon, a small lake in the Nelson Province, lying close under the Spencer Mountain Range, and upon the borders of which the station buildings connected with a run occupied by me are situated. The water of this lake is generally very warm, and even in severe seasons, has never been frozen over. To this fact I attribute the circumstance that some of these birds are to be found upon it throughout the year. There are several apparently permanent nests on the borders of the lake, which have been occupied by pairs of birds for many years in succession, from which I am led to infer that, as in the case of some of the *Anatidæ,* these birds pair for life. The nests are built amongst the twiggy branches of trees which have fallen from the banks of the lake, and now lie half floating in its waters, and are formed of irregularly laid masses of various species of pond weeds, chiefly of *Potamogeton,* found growing in the lake, and which the birds obtain by diving. They are but little raised above the surface of the water, for, in consequence of the position and structure of its feet, and

the general form of its body, the Grebe is unable to raise itself upon the former unless the body be in great measure supported by water.

The eggs are usually three in number, and are somewhat peculiar in form, having an apparent thickening in the middle and tapering towards both ends. When first laid they are of a chalky and slightly greenish hue, but soon become completely discolored. Whether this discoloration is solely due to contact with the materials of the nest, or whether the birds themselves, under the influence of some instinctive habit, contribute towards it, I am not prepared to say.

It has been suggested by observers that the discoloration of the eggs of some of the water birds is due, in part at least, to voluntary action of the parent birds. In this connection the Rev. J. C. Atkinson, a very close observer, tells us in reference to the eggs of *Podiceps minor*, that "when first extruded they are perfectly white, but seldom remain long so, gradually becoming of a stale blood-stain hue, from which there are gradations to a more or less dirt-bedabbled white, all eventually becoming of one dirty muddy red-brown;" and he enquires, "to what cause is this coloring due? is it intentional on the part of the bird, or is it accidental?" He does not believe that the colour "is, in any case, due to mud from the feet of the bird, nor that it is altogether derived from the weeds with which the eggs are usually covered during the absence of the birds from the nest;" for he mentions that he met with a nest of *Podiceps minor*, with a single egg in it, evidently very recently laid, uncovered as it lay in the nest, but which was stained of a dull mottled dirt colour all over. He worked at it with water and his fingers, and after much labour brought it back to a dirty mottled white, but he says, "that had he expended one-tenth part of the same labour upon a soiled hen's egg, he would have succeeded in restoring its original whiteness." But this point is one which I merely suggest here for the consideration of future observers, having formed no absolute opinion of my own upon it. I am, however, inclined to think against any intentional action on the part of the bird in producing the discoloration of the egg, for I believe that were such a discoloration necessary for the protection of a species having so wide a range, it would be exhibited by the egg itself immediately upon its extrusion, as in the case of gulls and other birds which form slight open nests in exposed situations, in which cases the eggs (and even the young birds proceeding from them), are so much assimilated in general colour to the ground on which they are deposited, as not to be detected without close search.

Both the male and female Grebe assist in the labour of incubation, although I believe that the chief part of this task devolves upon the female, and that she is only relieved by her partner for the purpose of enabling her to feed. Before the actual work of incubation commences, the eggs are usually covered with pond weed during the absence of the birds from the nest, but afterwards

the nest is seldom, if ever, left by both birds, except under unusual circumstances.

The New Zealand bird, as might be expected from its more recent contact with civilized man, is far less shy than the European one, and easily discriminates between persons who may be dangerous, and those who are not. The children of my manager frequently visit the nests during the progress of incubation, and as they have never injured the nests or eggs, or interfered mischievously with the birds themselves, they are allowed to approach quite close without the latter thinking it necessary to quit the nest. When they do so, they glide into the water with a quick but stealthy motion, diving at once, and rising at a considerable distance from the nest.

The eggs do not appear to suffer from immersion in water, even for a considerable time, for on one occasion, three eggs which by some means had been thrown out of a nest, and had sunk below it to a depth of several feet, and which must have been immersed in the water for twenty-four hours at least, were replaced by one of the children, and the parent birds having sat upon them, two out of the three produced chicks.

When the water of the lake is rising, in consequence of heavy rain, the birds are seen busily engaged in procuring material and building up the nest so as to raise the eggs above the reach of the flood. This added material is afterwards spread out after the water subsides; but on some rare occasions the rise of the lake has been so great and so rapid, that the birds having been unable to meet it, the eggs have become addled. In such case no chicks have been produced that season.

The young birds are of a greyish green colour, striped with black, and, particularly when of small size, are not easily detected whilst floating on the water. They take to the water immediately after being excluded from the egg, and both parents exhibit the greatest solicitude in tending and feeding them. When fatigued, they are carried on the backs of the old birds, taking their station immediately behind the insertion of the wings, for which purpose the parent bird immerses itself deeper than usual in the water.

Mr. Yarrell, in his description of the Crested Grebe of Europe, says,—"The parent birds are very careful of their young, taking them down with them for security under their wings when they dive." This is certainly not the case with the New Zealand birds, for I have frequently observed the parent birds, both when engaged undisturbed in feeding the young ones, and when pursued by a boat for the express purpose of noting their habits. In no instance did I see the young one being taken down by the parent when diving. It dives itself with great ease, and travels a considerable distance under water. From its inconspicuous colour and small size it easily eludes observation, more particularly if there be the slightest ripple on the water, and this is quite sufficient protection for it. When engaged in feeding their young, each

parent bird dives in succession, the young ones remaining on the surface, but with the body fully immersed, so as to leave nothing but the small head and neck visible. The habit of carrying the young on their backs, and of diving in order to shake them off when the young birds exhibit a determined disinclination to leave their snug station, has probably led to the error referred to. I have seen the parent frequently endeavouring to shake off the young one, which, judging from its outcries, disliked and resisted the attempt, until removed in the manner I have mentioned. Nor is the suggestion of Mr. Yarrell at all consistent with the fact that the Grebe, when diving, uses its wings to add to its velocity.

Although the Grebe reluctantly takes to flight, there is no doubt that it flies without any great difficulty, for it is found in situations which it can only reach by rising considerably above the general level of the ground.

I have never seen two or more pairs of birds associating together, or mingling with the various species of ducks also inhabiting the same lake; no pair, however, appears to confine itself to any particular station, except when accompanied by young ones, in which case they do not ramble far from the nest until the young ones have attained a considerable size. I visited the nests frequently at night, but never found them occupied after the young were hatched out, but I have found it warm, as if recently occupied; the birds, no doubt, left it on the approach of the boat, but their quiet stealthy motion prevented my hearing them do so.

Art. XV. — *Notes upon a New Zealand Flesh-fly.*

By W. T. L. Travers, F.L.S.

[*Read before the Wellington Philosophical Society, November* 12, 1870.]

The following notes upon a Flesh-fly, commonly known to the settlers in these Islands as the "Blue-bottle-fly," may not be uninteresting. I may premise, that I have no means of comparing its external appearance or structure with those of the Blue-bottle-fly (*Musca vomitoris*) of Europe, and am, therefore, unable to say how far, in these respects, it resembles or differs from that insect, but the annexed description of its external appearance (which I have endeavoured to make as accurate as my limited acquaintance with insect structure has permitted me to do), will probably enable those who are acquainted with the English fly to determine the character and extent of difference or resemblance between them.

The head is blackish brown, with a few yellow markings upon the cheeks, not sufficient however to give any general yellow tinge to the head; surface of the eyes clothed with minute soft hairs, the other parts of the head covered

with stiff hairs; antennæ short, springing laterally from peculiar, almost club-shaped, processes, placed in oval cavities immediately above the mouth; these processes are destitute of hairs, and are attached to the forehead by separate pivot joints, independent of those upon which the antennæ turn; thorax black, and generally hairy, with a few stiff longish hairs scattered over the surface; abdomen deep metallic blue, with stiff hairs symmetrically set all over it; the wings at the point of attachment have a yellowish hue, and the halteres are yellow; legs black, and covered with stiff hairs; fourth joint of the tarsus bilobed; terminal joint bearing two claws at the tip, with a smaller spurious claw between them, projecting beyond the outer margin of the pulvilli, which, between the larger claws, are hollowed into a semicircle. Length 7 lines, by 4 lines.

From this description, it will at once be seen that this fly differs materially from that described by Dieffenbach, in his short account of the natural history of these Islands, as the "Blue-bottle-fly," and that it is not the same as that which is described by Mr. Taylor in *Te Ika a Maui*, under the name of "*Musca* (*sarcophaga*) *læmica*, or Rango of the natives." There is a blue fly in these Islands which is viviparous, but which is much smaller than that known as the common Blue-bottle. It appears, moreover, to be confined to warm localities, and is seldom seen except during the summer and autumn months. As the result of enquiries amongst the natives (who are in general very observant of facts in natural history), I was at one time induced to believe that the Blue-bottle-fly (the subject of these notes) was not indigenous. They stated that this fly, with the common house-fly and certain flies which more particularly infest imported European animals, were all brought to the Islands by trading vessels from Australia, but, although I fully believe this in regard to several of these insects, I doubt it as regards the Blue-bottle-fly, for reasons which will be manifest from these notes.

For example, I may state (and this fact will be confirmed by every bush traveller and explorer in these Islands) that there is scarcely an attainable locality in which it is not to be found. I, myself, have seen it in the midst of dense forests, never before trodden by the foot of man, far removed from every habitation, whether native or European, and to which no cattle could ever have had access; in river courses, presenting for miles a mere expanse of naked sand and shingle; and, stranger still, upon the very summits of mountains composed of bare rock, and rising above the line of perpetual snow. In fact, within a few minutes after the explorer has sat down to rest, wherever the situation may be and whatever the season of the year, he is sure, if the weather be dry, to hear the hum of those busy active creatures as they gather around him. As an illustration of how fully they are looked for, I extract the following passage from Louper's account of the late Mr. Whitcombe's journey to the West Coast:—"We soon reached a dry spot, opened our swags, and laid

everything in the sun, and then lay down ourselves. We could not see any blow-flies about, of which there are so many in all parts of the country. I soon fell asleep; I think Mr. Whitcombe did the same, but he awoke first, looked at his watch, and said we had been resting for an hour and a half, that we must pack up, and get on our way. I quickly set to work to tie up my swag, but the blow-flies had found us out, and had covered everything with their eggs. His opossum rug was the worst; we cleaned everything as well as we could, packed them up, and descended once more among the spray."

The situation referred to in the above extract was some few miles beyond the Rakaia saddle, on the western side, and in the very heart of the Southern Alps, a locality remote from all human habitations, and probably never before visited by man.

The circumstance above referred to indicates that the sense of smell in these creatures, or at least "that power which communicates analogous intimations to the sensorium," is highly developed, for it has been observed that the distance from which they collect is often very great indeed. Whether the peculiar club-shaped processes upon which the antennæ are fixed are organs of smell, is a point upon which I am not able to offer any positive opinion, though, from the fact that many distinguished writers on insect structure have assigned their olfactory perceptions to various appendages of the head, and from the apparent connection of the antennæ with these perceptions, I am led to conjecture that the organs in question have some important relation with that sense. This is a point, however, which I must leave to be determined by those who are better acquainted with insect anatomy and physiology.

In connection with the numbers and very general distribution of the fly in question, it has often been matter of wonder upon what it feeds, and how it is propagated in many of the localities in which it abounds. For example, in the recesses of the forests and upon the summits of alpine mountains the amount of animal life of any kind, and consequently of decomposing animal matter, is extremely small, and if we except decaying vegetable matter in the forests, there is nothing to be seen which is even apparently capable of affording food to its larvæ. I may state, too, that although I often searched most diligently, I never found any of the larvæ in such situations. So completely are these points involved in mystery to me, that I am unable even to hazard a conjecture on the subject. In England, the annoyance suffered by sheep from the attacks of the flesh-fly is matter of notoriety, and I believe it has been asserted, that unless constant attention were paid to these animals when labouring under diarrhœa, or when suffering from wounds, they would soon be devoured by its insatiable larvæ.

Now, it is somewhat marvellous, and certainly providential, that none of the Flesh-flies of these Islands (of which there are several species) are known to annoy the living sheep, except when "cast," that is, when lying upon its back

or side, unable to rise. In such circumstances the common Blue-bottle at once attacks it, depositing its ova upon every part of the animal's body, and, no doubt, many sheep are thus annually destroyed; but, whilst the sheep is standing, or lying in its ordinary posture, it is apparently perfectly safe. Not so, however, with the shorn fleece, for no sooner has this been removed from the sheep's back than it is attacked; so with the skin or the meat of the dead animal, but except in the case above mentioned the living animal is never molested. This will appear the more singular when we find that the disease called "scab" is prevalent amongst the flocks in many parts of the Islands, and that sheep infected with this disease often remain undressed for weeks after the pustules have begun to discharge. But for this immunity from attack, there is no doubt that sheep farmers would annually suffer very severe losses. Whether this immunity will continue when sheep are systematically kept upon artificial pastures, has yet to be determined.

As an instance of an apparent perversion of the natural instincts of this creature, I may mention that it will, under certain circumstances, deposit its ova upon any woollen fabric, even of the finest texture; but it only attacks such articles when lying on the ground or rolled up in a bundle, and so forth. If fairly hung from a line, or spread over a bush, they are perfectly safe. I have often seen hundreds of these flies sitting upon the surface of a blanket thus suspended, without depositing a single egg, whilst below, on one incautiously spread upon the ground by some newly-arrived emigrant, I have seen the ova in masses many inches deep, and covering several square feet, the blanket itself being actually stiffened from the numbers deposited upon it. I once saw one of these flies most diligently attaching its ova to the dry surface of a glass bottle, taken, however, from saddle-bags which had recently been in contact with the sweating side of a horse.

It is remarkable, too, that in flight this insect is not known to rise more than six or seven feet from the surface of the ground. So well ascertained is this fact, that upon the sheep and cattle stations in the Middle Island the meat used for food is usually hung in the open air, at a height of nine or ten feet from the ground, and is there deemed to be quite safe from attack, whilst if kept below six or seven feet it is at once blown.

It has been stated, too, that the number of these flies is found to diminish whenever the common house-fly appears, and a squatter observing this, and anxious to mitigate the annoyance they caused, once attempted to convey some house-flies from Christchurch to his station on the hills. He succeeded in carrying them as far as an accommodation house, at the end of his first day's journey, but having unthinkingly let them out "to feed," was unable (as my informant stated) to catch them again. I have not heard whether the attempt was repeated, but its failure in the first instance is to be regretted, as the result of so direct an experiment would have been instructive.

I must now state, in conclusion (in justice to our insect), that in addition to its known functions as a scavenger, I believe it to be an important agent in the fertilization of flowers. I have often observed it extracting honey, and I have no doubt that pollen grains becoming attached to the delicate fringe of hairs on its foot, or entangled in the coarse hairs upon its legs and body, are those conveyed from the stamens to the stigmatic surfaces, even in the case of diœcious plants. There is in fact no doubt that, although its more disagreeable habits are those which are most striking, it will be found upon closer observation to possess, in common with all God's creatures, other habits which ought to render it less obnoxious to man.

Art. XVI. — *On the Absence of the Eel from the Upper Waters of the Waiau-ua and its Tributaries.* By W. T. L. Travers, F.L.S.

[*Read before the Wellington Philosophical Society, November* 12, 1870.]

During one of my earliest visits to a cattle station which I hold in the Valley of the Upper Waiau, a large river rising in and flowing along the eastern base of the Spencer Mountains, in the Nelson Province, I was informed by my manager that no Eels were to be found, either in the main river or in any of its tributaries, above a line of rapids which occurs some thirty miles below its source. Considering the almost universal distribution of the Eel in New Zealand, I was much struck by this statement, which at the time I was inclined to doubt, but which has since received at least negative proof, from the circumstance that although we have frequently fished for Eels in various parts of the main river and of its tributaries, and Lake Guyon, the outlet of which falls into it, we have never found any trace of them.

The absence of Eels in the Lower Danube (a fact apparently well attested) has been attempted to be accounted for, in part by the increased coldness of the water received below Ulm, from the great tributaries which rise in the Alps, but, as I shall hereafter show, this alleged cause is open to doubt; even if this opinion were well founded however, it would not account for their absence from the Waiau, for although all its waters above the line of rapids referred to are derived from mountains of great altitude, and snow-capped throughout the hottest seasons of the year, and its waters are necessarily very cold, yet they do not differ in these respects from adjacent rivers in which Eels are abundant. For example, the River Clarence, flowing to the eastward of, and parallel to, the Waiau, and within a distance of only four or five miles, and rising in the same chain of mountains; and the River Maruia, a large tributary of the Buller, also rising in the same chain and flowing to the westward, and, for a short distance, parallel to the Waiau (the waters of both of which are even colder

than those of the latter), contain an abundance of Eels of excellent quality. Nor is there any difference whatsoever in the character of the rocks over which these several rivers flow; the mountains are generally composed of crystalline sandstones, the main rivers running with their strike, whilst the tributaries usually cut through them nearly at right angles. Nor can the absence of these fish be accounted for by want of appropriate food, for Lake Guyon and all the smaller and less rapid streams abound in various species of Galaxias, and in other forms of animal life.

We are, therefore, driven to conclude, either that migration to the sea is essential to the Eel of this country, and that some physical obstacle exists which prevents its return to the head waters of the river in question; or that it has been introduced into the river below the rapids (where it is abundant) since the formation of some physical obstacle to its further ascent.

If the absence of the fish in the upper parts of the river is to be attributed to the existence of a physical obstacle to its ascent, then the line of rapids to which I have referred as occurring some thirty miles below its source must be that obstacle. At this point the valley is very narrow, and the river which there contains a great body of water, has cut a channel nearly forty feet deep and about half a mile in length, through solid rock, along which it flows with great force. Judging, too, from the presence of numerous twirls and whirlpools, the bottom of these rapids appears to be rocky and uneven, whilst the rock on the sides, and, doubtless on the bottom also, has been highly polished by the attrition of the silt brought down during floods.

But it may be urged that Eels are well known to breed freely in Europe in fresh water habitats, without attempting to seek the sea, and that during the winter season they manage there to protect themselves from the increased rigour of the temperature by burying themselves in mud, or by hiding in holes in the banks of the rivers and ponds. Mr. Yarrell, indeed, expressly cites the Mole, the Wey, and the Longford rivers, and various ponds, as localities in which the Eel is found to breed freely, but from which it does not attempt to reach the sea; and we may be asked why should not the Eels of this country follow the same habit in the Upper Waiau, assuming that the rapids referred to prevent their ascent of the river? The coldness of the water during the winter season would not be sufficient to account for their absence, for Mr. Yarrell has shown that they are able to endure, without injury, a very rigorous temperature, and certainly the winter season of the district in question is not so inclement as that of many parts of England.

We are, therefore, driven back upon the two alternatives mentioned in the earlier part of these observations, and of these two I am disposed to rely upon the first, namely, that while migration to the sea is essential to the Eels of this country, a time arrived at which, although descent was practicable,

they could no longer overcome the physical obstacle to their ascent of the river, presented by the line of rapids referred to. I am the more inclined to adopt this opinion, because there is no obstacle to the passage of Eels from the Clarence or the Maruia into the upper waters of the Waiau. Maling's Pass is a low bog-saddle between the Clarence and the Waiau, from which water flows to each of these rivers. The Maruia, in like manner, is separated from the Ada (a large tributary of the Upper Waiau) by a similar bog-saddle, on which there are numerous ponds in direct communication with the waters of the two rivers; but, no doubt, any Eels which may find their way across these saddles into the Upper Waiau would run down the river at the spawning season.

It is interesting to observe that the valleys of the Waiau and Ada were on the direct line of route of the East Coast natives during their excursions to the West Coast in search of greenstone, or for man-hunting, and the Gorge of the Maruia, through which they passed before striking the head waters of the Grey, is known to this day by the name of the Kopi o kai tangata, or Cannibals' Gorge. During these excursions the natives evidently camped near Lake Guyon, for I have there obtained stone implements, fragments of the shell of the mutton fish, and other articles, and in a cave not far from the lake, the skeleton of a man, some fragments of matting, and a portion of an eel-basket, were found.

I do not conclude from the latter circumstance that Eels were to be found in the lake, or in the upper parts of the Waiau or its tributaries, at the time when the excursions referred to took place, but rather that it was intended for use either in the lakes on the western side of the Spencer Range, or in those at Tarndale on the route to the Kaikoura, which have long been celebrated amongst the natives of the latter place for the abundance and quality of their Eels.

On the whole I am disposed to attribute the absence of these fish from the district in question to the necessity for migration to the sea or to warmer parts of the river during the spawning season, and the inability of the fry, or even of the adult fish, to re-ascend the river beyond the line of rapids before referred to.

ART. XVII.—*Notes on the Skull of* Balæna marginata, *described in "Transactions of the New Zealand Institute," Vol.* ii., *p.* 26., *as the Type of a New Genus,* Neobalæna. By Dr. J. E. GRAY, F.R.S., etc.

[*Reprinted from "Annals and Magazine of Natural History,"* 1870, *p.* 154.]

[*Read before the Wellington Philosophical Society, October* 22, 1870.]

IN the essay on Whales published in the "Voyage of the Erebus and Terror" I established a species of true Whalebone-Whale on three examples of whalebone which I had received from Western Australia, believing it to belong to the same genus as the Greenland Whale (*Balæna*), as the whalebone was of long slender shape, and of a very fine texture, with a large quantity of enamel, which is a peculiarity of the baleen of that genus. Sir George Grey, the late Governor of New Zealand, has obtained the skull of *Balæna marginata* from the Island of Kawau, New Zealand, and has presented it to the Museum at Wellington. Dr. Hector has given figures exhibiting four views of this skull in the *Transactions and Proceedings of the New Zealand Institute* for 1869, Vol. ii., which was issued in April, 1870. These figures show that the whale, which has long, slender, and fine-textured whalebone or baleen like that of the Greenland Right Whale, forms a very different genus from the restricted genus *Balæna.* The brain-cavity forms a much larger part of the skull; the beak is much shorter and broader at the base, gradually tapering to a point in front; and the lower jaw bones are thin, compressed, and high, with the upper edge dilated and inflexed the greater part of their length, and the lower edge similarly dilated in the front part or chin.

I propose for this animal the name *Neobalæna*; and it may be thus characterized:—

NEOBALÆNA.

Skull rather depressed; brain-cavity nearly as long as the beak, depressed, much expanded on the sides, with a very deep notch on the middle of each side over the condyles of the lower jaw, and with a subtriangular crown-plate. The nose as broad as the expanded brain-cavity at the base, regularly attenuated to a fine point in front, and slightly arched downwards. Lower jaw laminar, compressed, high; the upper edge thin, and inflexed the greater part of its length, erect in front; the lower edge inflexed in front, the rest of the edge being simple. The baleen elongate, slender, several times as long as broad, with a fringe of a single series of fine fibres; enamelled surface smooth and polished, thick.

Neobalæna marginata.

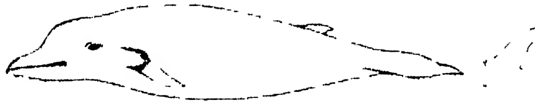
Balæna marginata, Gray, *Cat. Seals and Whales Brit. Mus*, p. 90; Hector, *Proc. and Trans. New Zealand Institute*, 1869, t. 2*b*. f. 1-4; *Ann. and Mag. Nat. Hist.*, 1870, Vol. v., p. 221.

Hab. New Zealand.

This is interesting, as showing that the true *Balæna* or Right Whale of the North Sea and that of the South Sea are each a peculiar genus.

The width and general form of the beak of the skull is somewhat like the beak of some of the Finner Whales; but it does not at all justify Mr. Knox's idea that *Balæna marginata* is a Finner. But this difference of skull makes us more anxious to have the description of the entire animal and its skeleton, as the animal may prove to be the type of a new family of Whales, between the true Whales and Finners.

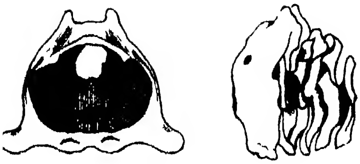
This pigmy whale, which is not more than 15 or 16 feet long, is a representative in the Southern Ocean of the gigantic Right Whale of the Greenland seas. It has the most beautiful, the most flexible, most elastic, and the toughest whalebone or baleen yet discovered; and if it were of larger size, it would fetch a much higher price than the whalebone of the Greenland whale, the latter being three or four times the value of the brittle coarse whalebone of the *Eubalæna* or Right Whales of the Southern and Pacific Oceans. The trade of the Continental nations being chiefly confined to their colonies, or their merchants obtaining the whalebone that is used in their manufactures second-hand, there are not in the market the varieties of whalebone and finner-bone which we have in this country, where the whalebone and finner-bone from different localities bear each a different value. This perhaps explains why the Continental zoologists (as Eschricht) who have paid attention to the structure of whales have not paid sufficient attention to the characters afforded by the shape, structure, and colour of this substance to which I called their attention more than twenty years ago, and showed its value as a character for distinguishing the genera and species. It has been a fertile subject of reproach to me that I established some species on the characters afforded by this substance; but I need only quote, as a proof of the little attention M. Gervais has paid to this part of my work, that, in his book on the anatomy of whales, now in progress, after saying that I have established the species *Balæna marginata* on three blades of whalebone, he says I have called it *Eubalæna marginata*—thus confounding it with the whales with brittle and coarse whalebone, whereas the chief reason that induced me to consider the blades to belong to a distinct species was their very fine and tough structure. The accuracy of the determination is now proved by the very different form of its skull from that of any other known whale. In the same manner, the *Physalus antarcticus*, also established on finner-fins or baleen imported from New Zealand, has been proved to be a very distinct species of that genus, named Sulphur-bottoms by the whalers.



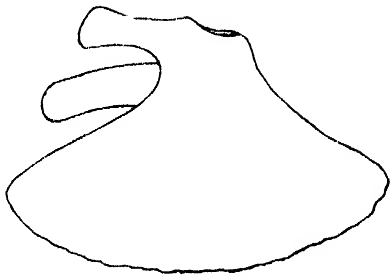
ZIPHID WHALE

See Papers by Knox & Hector

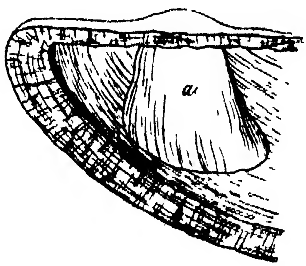
Profile of Species seen in 1862



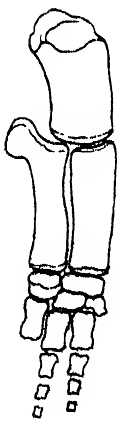
Cervical Vertebræ



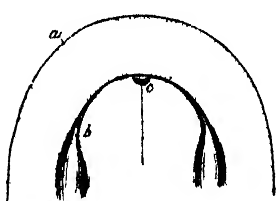
Scapula



Tooth enclosed in a capsule (a)
after removal of jaw



Anterior limb



Lower buccal surface.

(a) Lip when cuticle removed covered with minute h

(b.) Dental groove and dental prominences

(c.) Glandular orifice.

[illegible] del. J.B. lith.

Printed at the Gen. Gov. Lith. Press

anxiously looked for) could be detected, but upon a careful dissection, *and previous to maceration*, the tooth (Plate XVII., fig. 3 b) now before the Society was found; its twin brother still remains in its obscurity on the right ramus of the lower jaw.

From the appearance of the teeth, I am inclined to think that they never cut or appear above the gum, and the scientific enquirer will naturally ask of what use could they be to the animal? This is truly a profound question, and carries us into the mysteries of types and first causes. The tooth, it will be observed, is of the form of a compressed cone; the apex is finely pointed (not worn), and was found playing in a cavity, resembling a socket, in the jaw. The tooth is still covered to within about the eighth of an inch with an investure of cartilaginous tissue, but as I intend to carry out my investigation of not only this remarkable tooth, but also those of other Cetaceans, including the teeth of the sperm whale, I shall close my present remarks by stating, that from careful examination of the specimens which came under my notice, the food on which these animals subsist is the cuttle-fish; and these concealed teeth, although not answering the purpose of securing, killing, or grinding, would yet give a severe pinch to such soft-bodied animals.

I subjoin tables of weights and measurements so far as could be procured:—

No. 1. Killed in Porirua Harbour, January, 1862.

(Plate XIII., fig. 1.)

Total weight (supposed) . 5 tons.

Measurements.

	ft.	in.
Total length	27	0
Greatest circumference	14	0
Tail, from tip to tip	7	0
Head—length of basal surface	4	4
,, height	2	2
,, breadth across occiput	2	0
,, length of lower jaw	3	10
Length of pectoral extremity, free	3	0

Produce of fine sperm oil, about 240 gallons; spermaceti, a considerable quantity on the upper surface of the face..

No. 2. Killed in Titai Bay, Cook's Strait, January, 1866.

Total length	9	3
Greatest circumference	5	2
Head—from tip of jaw to nostrils	1	5
,, ,, ,, ,, eye	1	5
,, ,, ,, ,, gape	0	9

	ft.	in.
Head—total length of basal surface	2	0
„ breadth	1	0
„ height	1	0

No. 3. Killed at the entrance to Port Nicholson, January, 1870.

Total length	27	0
From beak to nostrils	3	6
„ nostrils to occipital foramen	1	6
Total length over vertex	5	0
Head—tip of beak to occipital foramen, basal surface	4	0
„ greatest height	2	0
„ length of lower jaw	3	10
„ „ symphysis	1	0
Breadth between condyles	1	10
„ at symphysis	0	6

[*Read before the Wellington Philosophical Society, June* 25, 1870.]

Since reading the preceding notice, I have made a section of the left tooth, as nearly in its axis as the curves of the tooth would allow, and without injuring the apex. It will be observed from this section that there is no cavity for lodging a pulp; it is composed of three distinct substances, well defined, not only by difference in colour but in organization, but just of sufficient hardness to take a fine polish; the centre part, forming much the greater proportion of the tooth, exhibits a homogeneous mass of fibres edged with a series of imbricated laminæ, more especially towards the apex, and these are covered with a white dense osseous tissue, precisely similar to the ivory or bone of the tooth of the sperm whale, of which I also have placed on the table a fine section. Lastly, enamelling the tooth from the base to within an eighth part of an inch of the apex, we have an osseous layer, not only holding the place of the enamel in other teeth, but presenting its peculiar and characteristic organization; the section, at the same time, shows the last mentioned tissue to be entirely covered by a substance similar to cartilage, as if it was in a state of growth by the deposit of enamelling matter.

The muscles chiefly performing the process of mastication are comparatively small, and would scarcely serve the purpose of seizing, killing, and grinding any resisting prey.

It is sufficiently interesting to remark that the *Delphinidæ* are characterized by the great number of teeth, some of them possessing as many as two hundred, whilst the *Ziphidæ*, the skeleton of which closely resembles the dolphin, may

be said to be toothless. Indeed, a careful anatomical examination of the lower jaw of the animal I am now describing, presents appearances strongly suggestive of the presence in the *fœtus* of numerous teeth. The canal for the dental nerve is remarkably large, and I experienced considerable difficulty in extracting a mass composed of large nervous filaments and blood vessels, evidently transmitting branches to, if not teeth, at least to the alveole and its living membrane or gum. Had the development of these supposed fœtal teeth been completed, the Cetacean under examination would have been a sperm whale, a Cachalot in short. The dissection of a fœtal mystecetus, made by myself, showed the existence of numerous teeth in *both jaws;* although at or before the birth of the animal, the development of these teeth is checked, and the nerves and nourishing vessels are appropriated to the development of baleen.

A question arises, is the specimen under consideration an adult animal? and, would these teeth be ultimately protruded? The present state of the question, as clearly indicated in Dr. Gray's eighth family of the *Cetaceæ*, would lead us to conclude that the tooth was a rudimentary affair; but I answer, its high organization, as shown in the section, leads me to question this view.

Notes on the Preparations mentioned in the foregoing Paper.

By Dr. HECTOR.

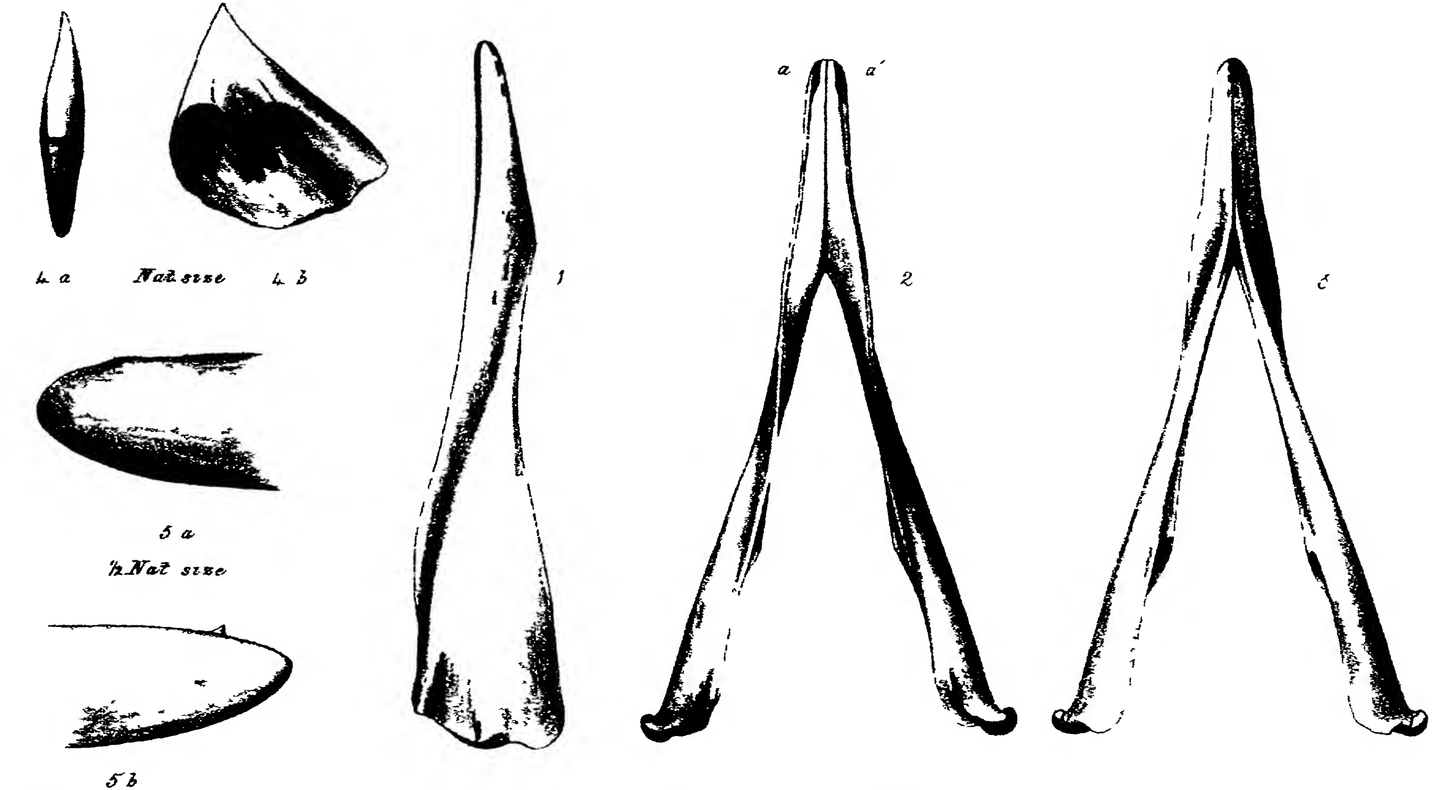
The three Whales described by Dr. Knox in the foregoing paper, are evidently to be classed with the Family *Ziphidæ*, as defined in Dr. Gray's *Catalogue of Seals and Whales*, p. 326.

Preparations of the second and third specimens referred to are deposited in the Colonial Museum, and have been carefully figured in the accompanying Plates XIV. to XVII.

Plate XIV. gives three views of the skull (two feet in length) of the young specimen that was captured in Porirua Harbour, in 1866, the dimensions of which have already been given (*Trans.*, Vol. ii., p. 27.).

Figure 1 is the side view without the lower jaw, Figure 2 shows the upper surface, and Figure 3 the lower surface of the same. The curious obliquity of the skull, which twists forwards and upwards to right half of it, as shown in the drawing, especially by the relative position of the two segments of the blow-hole, is matter of remark, as it is found to exist in all the specimens of whales and their allies yet examined, and probably corelates with some modification of the progress of the animal through the water, to enable it to enjoy direct forward vision.

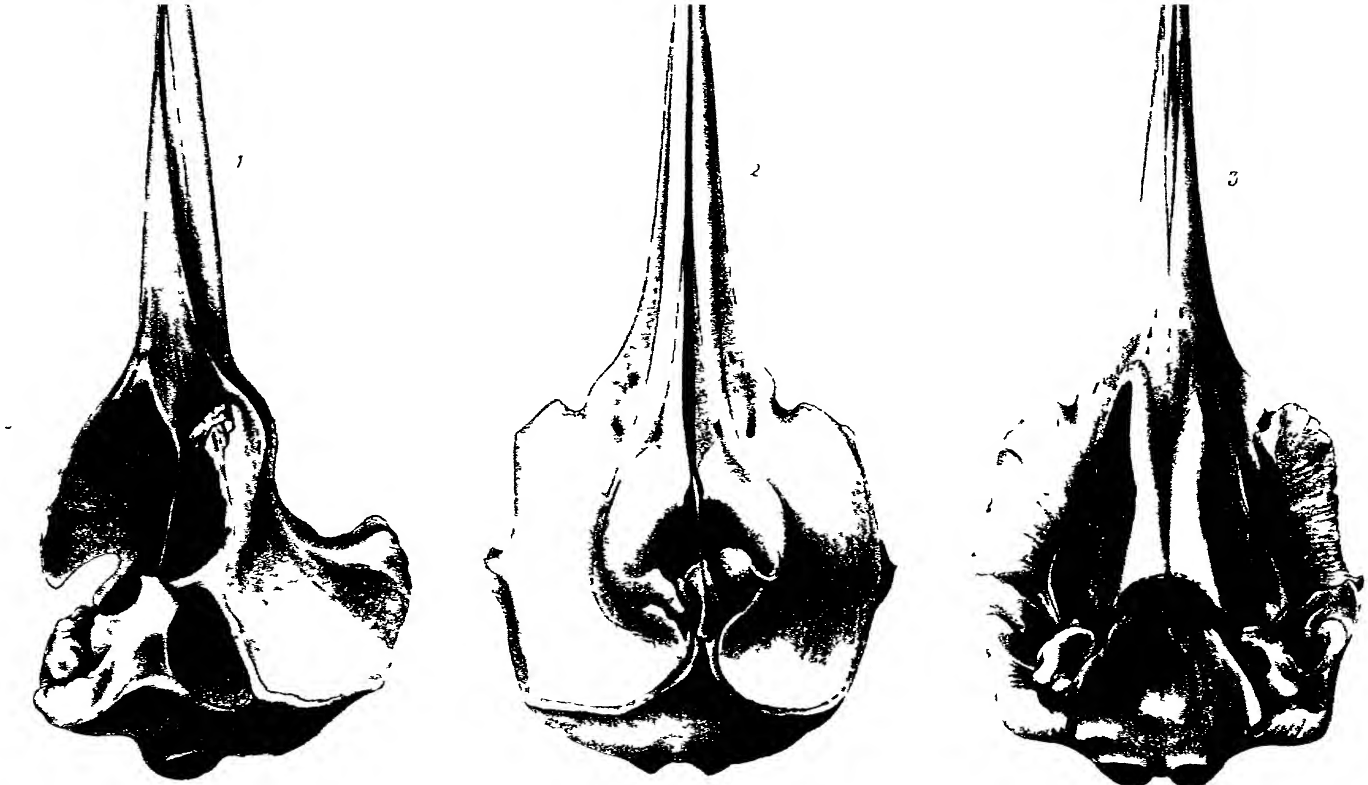
Plate XV. gives three views of the lower jaw belonging to the same head. In Figures 1 and 3, which are the profile and inferior views, it will be observed



LOWER JAW of ZIPH D WHALE

Smaller specimen Figs 1 2 3. 1/5 Nat. size See Paper by Knox & Hector

Printed at the Gen. Gov. Lith. Press



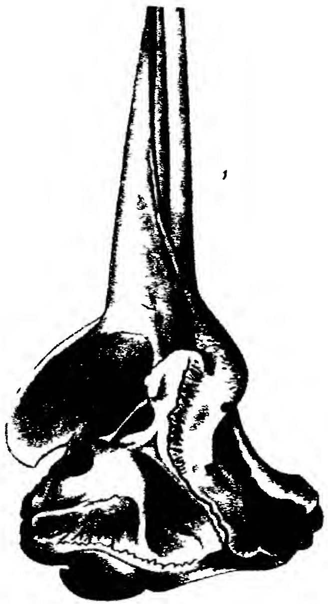
J.B. del. et lith.

Printed at the Gen. Gov. Lith. Press

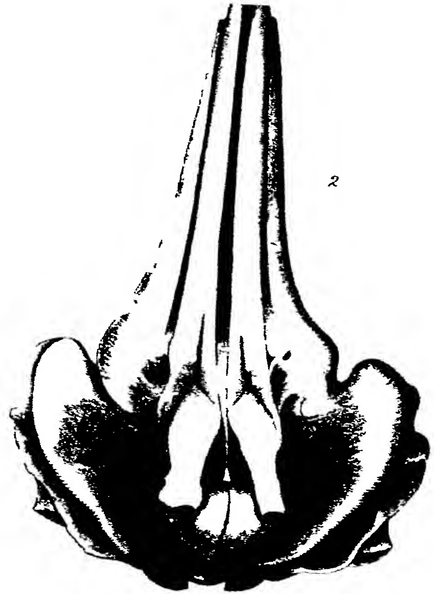
Smaller specimen Fig 1 2 3 ·5 Nat size See Paper by Knox & Hector

1

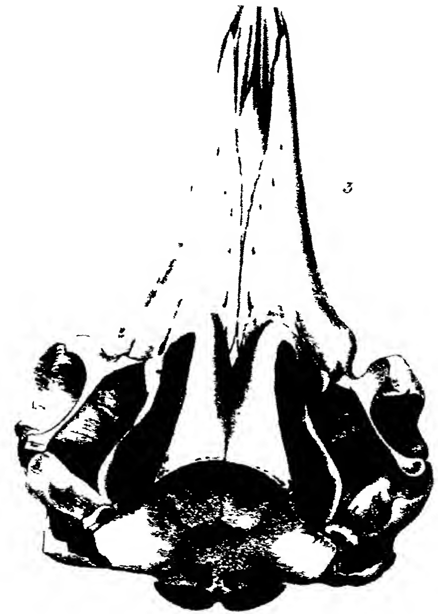
1



2



3

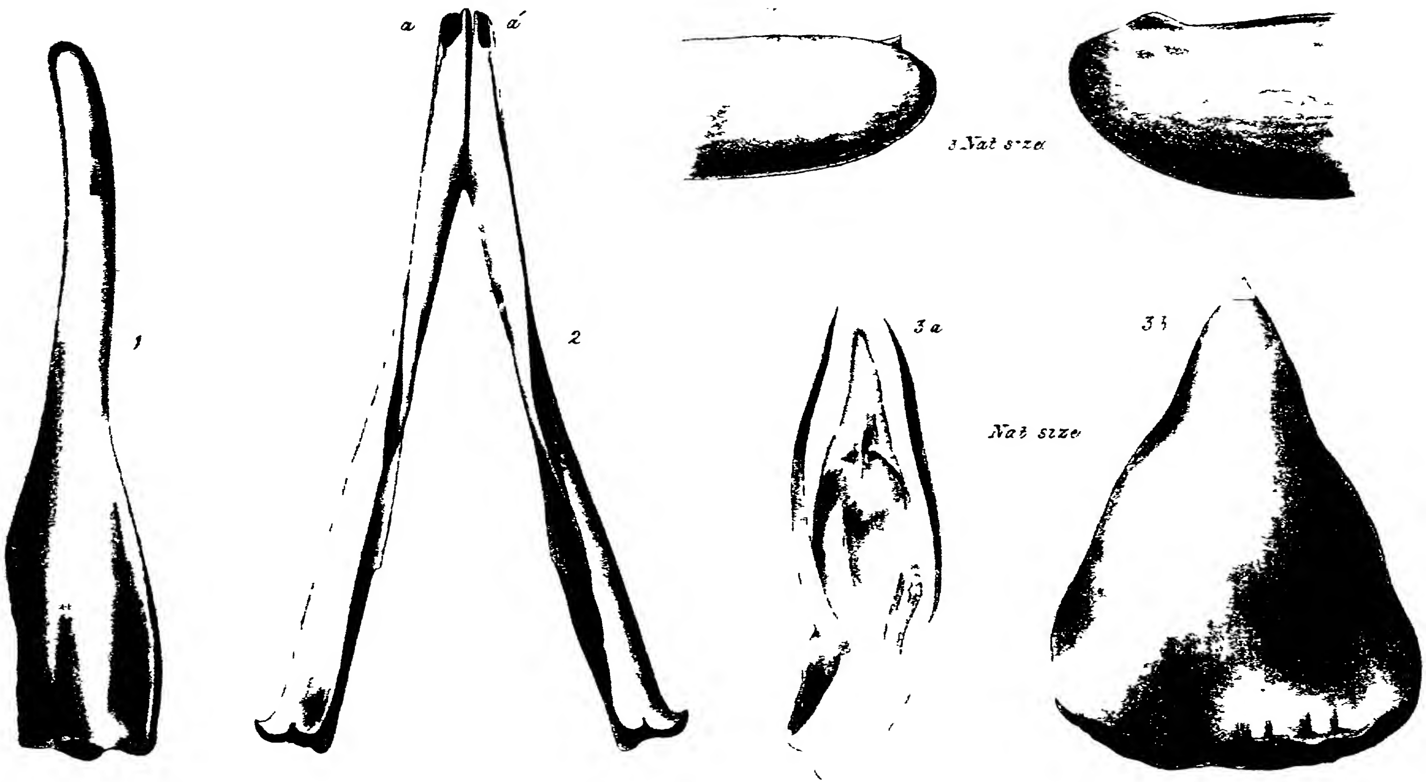


J.B. del. et lith.

SKULL OF ZIPHID WHALE

Larger specimen Figs 1 2 3. 1/11 Nat size See Paper by Knox & Hector

Printed at the Gen. Gov. Lith. Press



J.B del et lith

LOWER JAW of ZIPHID WHALE

Larger specimen Figs 1, 2 3 1/11 Nat size See Paper by Knox & Hector

Printed at the Gen. Geo. Lith. Press

that there are three nutrient canals at the tip of the jaw on each side, probably indicating the normal number of teeth. In Figure 2, which shows the upper surface of the jaw, there is only one socket on each side (*a* and *a'*), which held the tooth figured of natural size (4a and 4b.) The upper conical part of this tooth has a polished surface, but never protrudes through the gum.

This is well shown in Figures 5a and 5b, the first of which shows the left side of the top of the jaw, with the integuments still in place, the position of the tooth being only revealed by a slight elevation without any aperture. The second shows the opposite side of the jaw with the integuments removed, and the tooth which came away imbedded in a fold of the gum, dissected out and replaced in the socket.

Plate XVI. gives the superior, inferior, and profile views of the skull of the third specimen referred to by Dr. Knox; the dimensions of which are as follow:—

	in.
Length of head	59·5
„ nose	31·0
„ dental groove	15·0
„ lower jaw	43·0
Width of notch	14·5
„ at orbits	24·5
„ blow-holes	7·0
„ nose	5·0
Height of occiput	19·5

Plate XVII. gives the corresponding view of the lower jaw (Figures 1 and 2), and also the tooth (Figures 3a and 3b), both in side view and in section, showing the internal structure. The form of the tooth is more turned than in the other specimen, but the variety is probably due to age.

The preparation of the nose (Figures 4a and 4b), show that notwithstanding this is a full-sized animal, the tooth is still sheathed in the gum, being imbedded in a tough cartilaginous sac, which adheres loosely in the socket of the jaw, and is moved by a series of muscular bundles that elevate and depress it.

The accompanying drawings (Plate XIII., figs. 2, 3 and 4) give the anterior view of the atlas and six combined cervical vertebra, also the scapula and anterior limb.

Art. XIX.—*Short Notice of a remarkable Tooth of a Cetacean.* By F. J. Knox, L.R.C.S.E.

[*Read before the Wellington Philosophical Society, November 12, 1870.*]

The tooth now exhibited before the Society is the property of a friend, and in the course of a conversation with him, was kindly shown to me. I observed numerous points of difference from the specimens in my possession—unmistakably recognized as those of the Cachalot, or sperm whale; and, by the kind permission of my friend, had a section made of it, carrying the saw as nearly as possible in a curved line, following the axis of the tooth. This truly magnificent section, for the cutting of which I am indebted to my friend, Mr. Kebbell, displays a surface at once of the most artistic beauty, and, to me, perfectly novel. The nearly total absence of a dental cavity for the nervous pulp, found in all the teeth of the Cachalot I have had an opportunity of examining, and, indeed, the general form of the tooth, viewed externally, suggests to me the probability of its having been the tooth of a dolphin, allied to the Ziphid family of Dr. Gray; and looking over Dr. Gray's Catalogue, my attention was forcibly drawn to that of the *Ziphius Sowerbii*, of which an engraving is given (Table 37).

It appears that the specimen of the skull from which the engraving is taken is in the Oxford Museum, and the engraving appeared when first seen by me so unnatural as to create a doubt in my mind as to its history, and consequent value to science. It would be most interesting to obtain the history of the cranium, however meagre, more especially as to the external appearance of the animal previous to dissection. Did the teeth protrude through the gum? This is a most important point, as in the case of Hunter's Bottle-nose, the animal has evidently been christened under different names by succeeding naturalists not less than six or eight times.

Art. XX.—*Observations on* Coridodax pullus. By F. J. Knox, L.R.C.S.E.

(With Illustrations.)

[*Read before the Wellington Philosophical Society, October 22, 1870.*]

The specimen forming the subject of this brief notice was of medium size, and gave the following weight and measurements :—

Weight . . . . 4 lbs. 4 ozs.

Measurements.

	ft.	in.	lines.
From tip of snout to tip of tail (straight) .	1	8	6
Greatest girth behind ventral fin . .	1	0	0

On placing in the Museum the skeleton of a species of fish familiarly known to the practical fisherman as the Kelp-fish, I shall confine my observations to the remarkable circumstance of the skeleton presenting a bright or bluish green colour, which is so permanent as to resist the process of prolonged maceration and subsequent bleaching, and even boiling. The question arises, whether the food is the cause of this. Careful dissection and enquiry into the habitat, and consequently feeding ground, has, I presume to think, at least to a great extent determined this.

On the second day of August last (1870), a large quantity of the Kelp-fish were offered for sale in and about Wellington, and although by no means prepossessing in external appearance, being of a dingy black colour and covered with a slimy mucus, a few were purchased. My first enquiry was, when, where, and how they were captured. I found that the fish frequent Cook's Strait, more especially off and around the Island of Mana; they are very rarely taken with a bait, but are fished for by means of a net in the form of a bag with a hoop round the mouth, and secured with a rope to a branch of the kelp, which grows of vast dimensions around the Island of Mana. The net is *set* amongst the kelp, where the rise and fall of the tide produces a kind of free run, which the fishermen avail themselves of in setting their net, and upon returning they find it full of the fish, of all sizes. The kelp in this locality may be viewed as a vast submerged forest, growing from stems two or more feet in circumference, fixed to the bottom of the sea, and is often used by the Cook's Strait fishermen and captains of small coasting vessels to secure their crafts to in a gale of wind. The fish, I have said, are covered with a slimy mucus, like that of the eel, and gives a feeling to the hand similar to that of the kelp, so that the movements of the fish (provided, as it is, with ample fins) must bear a strong resemblance in its gliding amongst the branches of the submarine forest to that of the *Athene Novæ Zelandiæ*, in his nightly silent flight amongst the surpassingly beautiful terrestrial forest.

Ovaria resembling in size and number that of the trout. The ova were vascular, and many floating free, indicating that the fish were spawning, and consequently ought to be in the very best condition.

As an accurate drawing of the external appearance of the fish has been made by Mr. Buchanan (see Plate XVIII., fig. 2), I shall merely add a few notes on the anatomy.

Stomach, a simple sac; diameter 1½ inches, diminishing in calibre gradually to 6 lines, (no pancreatic cœca); tunics of the stomach thin, distended, with a green semi-fluid mass; peritoneal tunic bright silvery. Intestine 3 feet 4 inches in length. Liver pale yellow colour, friable, no oil; composed of four irregularly-shaped lobes; gall-bladder not observed. Spleen comparatively small, dark, like a clot of blood. Kidneys placed near the head, extending along the spine for about 4½ inches; concealed by the swimming bladder,

5 inches long, attached to the transverse processes; the swimming bladder was very fully distended; the tunics strong opaque.

Food, a species of zoophyte, or animal-plant of naturalists.

The dentition is very peculiar, more especially the pharyngeal; the upper and lower pharyngeal bones are of a deep green colour, and present together a complete system of minutely serrated edges, and being acted upon by powerful muscles, typify all the forms of straight and circular saws at present in use in the most completely furnished saw mills.

SKELETON.

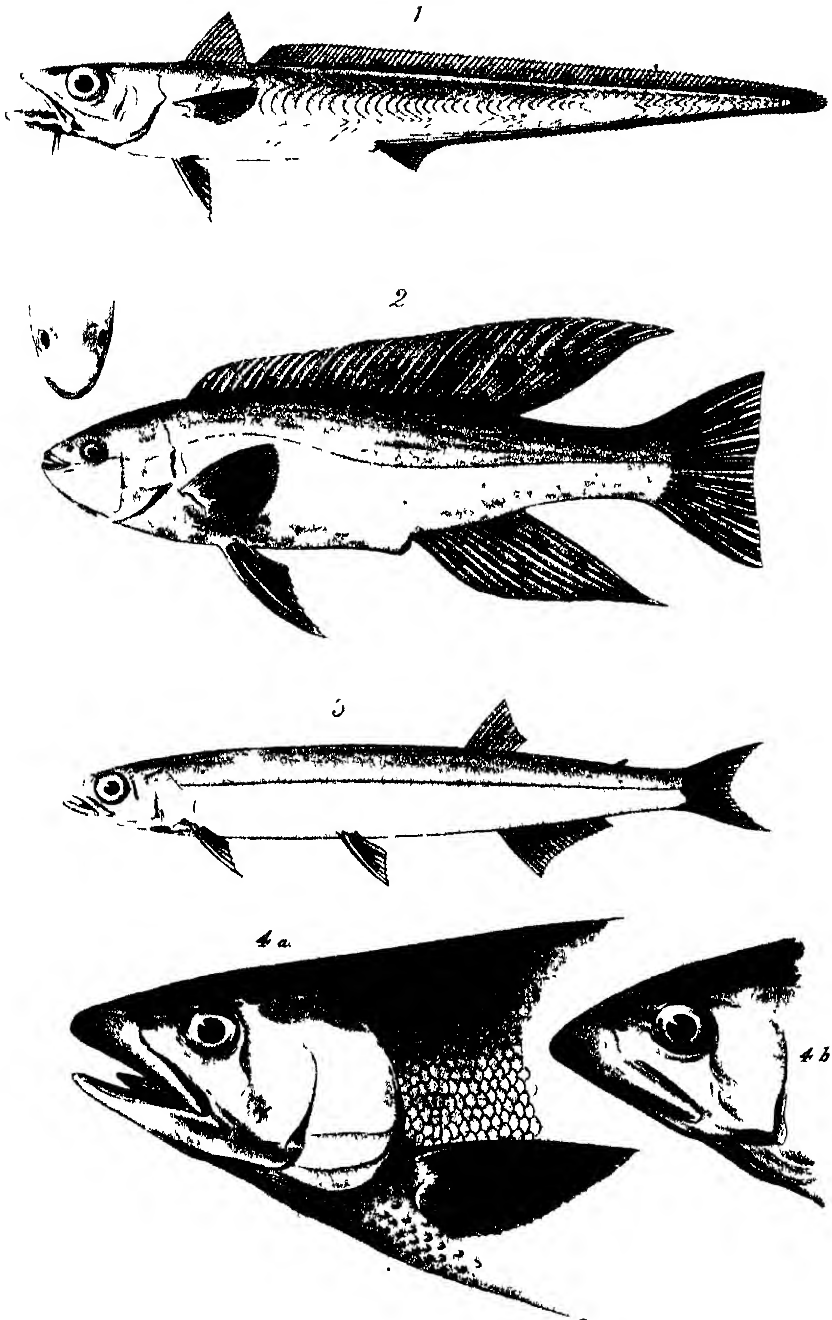
	oz.	grs
Head	1	0
Spine, with dorsal and caudal fins	2	0
Pectoral extremities	0	200
Pelvic ,,	0	80
Hyoid and bronchial arches	0	120
Pharyngeal bones	0	46
Total weight	3	446

VERTEBRA.

	No.
Body	27
Caudal	21
Total	48
Ribs	27

ABSTRACT.

	lbs.	oz.	grs.
Weight of entire fish	4	4	0
Weight of skeleton	0	3	446
Weight of soft parts	4	0	34



1. CORYPHÆNOIDES NOVÆ ZELANDIÆ, Hector, n. s. 2. CORIDODAX PULLUS, Gunther.
3. RETROPINNA RICHARDSONII, Gill. 4. COREGONUS UPOKORORO, Hector, n. s.

Printed at the Geo. Geological Press by J. Harris

Art. XXI. — *On the* Salmonidæ *of New Zealand.*

By James Hector, M.D., F.R.S.

(Plates XVIII. figs. 4a and 4b, and XIX.)

[*Read before the Wellington Philosophical Society, June* 25, 1870.]

During the last few years, Salmon and several varieties of Trout have been introduced from England into the Australasian waters, and the Trout, at least, has been successfully established, both in this colony and Tasmania. Those reared in Nelson, and turned out in the Maitai stream, have already reached the full size, so that if they prove as prolific as in the native country of the species, we may expect soon to have the favoured streams, for a short season at least in each year, thrown open to the angler.

An inquiry, therefore, into the species of fish indigenous to our streams which belong to the same family, some of which might be confounded with the introduced Trout by a casual observer, has a peculiar interest, and though the materials yet obtained are scanty, they are advanced in the hope of inducing further communications on the subject.

The chief distinguishing character of all fish that belong to the *Salmonidæ* is the possession of a second dorsal fin, which consists merely of a small fleshy lobe without rays or membrane like the other fins.

In English Ichthyology the *Trouts* (including the Salmon of the fish market) form one division of this family, the other division having the smelts, grayling, and fresh-water herrings.

The representatives of the family in New Zealand belong to the latter miscellaneous group ; the only species hitherto distinguished being referred to a genus (*Retropinna*) peculiar to these Islands.

This little fish, which is common in all the streams, was first named by Richardson, *Argentina retropinna* (*Voy. Ereb. and Terr.*, Ichth., p. 121), but was afterwards separated from this genus and described as *Retropinna Richardsonii*, Gill (*Proc. Acad. Nat. Science, Philadelphia*, 1852, p. 14).

Under this name it is described in Dr. Günther's *Catalogue of the Fishes in the Brit. Mus.*, Vol. vi., p. 171, of which description the following is an abstract :—

Genus. Retropinna.

Cleft of mouth of moderate width. Teeth small, in single series, with a cluster of hooked teeth on the tongue. Dorsal fin set far behind the ventrals, and above the vent. Stomach thick, and of horse-shoe shape. No pyloric appendages or air bladder. Ventral fin 6-rayed.

Species. *Retropinna Richardsonii.*

Native name, Inanga.*

Height of body less than length of head, and $4\frac{2}{3}$ times its length without

* Also applied to the young of *Galaxias*.

caudal. Snout shorter than eye. Lower jaw longer. Silvery band along the side. P. 11. V. 6. D. 11. A. 20. B. 6.

Plate XVIII., fig. 3, is a careful drawing of a specimen of this fish caught in the Kakapo Lake, on the West Coast of Otago. It differs a little from the drawing given in Richardson's work, but from the description there is no doubt of the identity of the fish with this species.

They swarm in the lakes, and in most of the clear deep streams, migrating at certain seasons; they are never found possessing the above characters of greater size than 3½ inches in length, and are generally called smelts, from their resemblance to that fish, and also from their having, when fresh, the peculiar strong scent of cucumber.

They are generally taken for the young of two other fish, which I will now describe:—

Retropinna osmeroides, n. sp.

Native name, Aua.*

P. 11. V. 6. D. 11. A. 19. B. 6. Body, without caudal, 3⅜ times length of head. Maxillary prolonged, clavate. Mouth wide, armed with strong teeth.

Plate XIX., fig. 1, shows this fish of natural size, obtained, in 1863, in the Kaduka River, a tidal stream which leads up from the sea to the Kakapo Lake. It does not appear to present any sufficiently distinct characters to remove it from the genus *Retropinna*, as above defined, except that the cleft of the mouth is wide and very different in form from that in the other species hitherto placed in that genus. The teeth are also much stronger, and on the vomer are quite as formidable as in the true smelt (*Osmerus*). The maxillary bone also presents a marked difference, for while in the previous species it is feeble and short, extending only to the eye, in this species it is elongated and terminates in a clavate expansion posterior to the eye; lower jaw projecting.

In the external characters, such as fin rays, position of fins, the shiny patch on the cheek and silvery line on the side, the two fishes are the same. The abdominal cavity in both also is lined with a silvery membrane with distinct dots of pigment, and the intestine is straight.

This fish was seen in October in immense shoals, leaping out of the water in a very lively fashion, and following the tide into all the narrow tributary streams to which the brackish water penetrated.

All the individuals were alike in size, the length being about 7 inches.

Retropinna Upokororo, n. sp.

Native name, Upokororo.

P. 15. V. 6. D. 11. A. 18. B. 6. Body, without caudal, 4½ times length of head. Mouth small and tumid, and teeth almost absent, or only in

* Also applied to *Dajaus Forsteri*, the Herring of the colonists.

one feeble row on upper jaw. Tongue short, feebly armed. Maxillary not extending beyond eye. Snout conical, and receiving the lower jaw, which is shorter. Dorsal fin over the ventral, and in advance of the vent. Abdominal cavity black. Intestine folded, and 3½ times the length of the abdomen. Stomach thin and membranous. Shiny patch on the cheek, but no silvery line on the side.

These characters at once distinguish this fish from either of the preceding species. It is possible that difference of growth might in them give rise to their distinguishing features, but this fish clearly differs in the dentition, form of mouth and intestine, which indicate a different kind of food, and also in the number of rays and position of the dorsal fin. The specimens I have obtained of this fish present a great deal of variety, but only in the colouring, which varies from a general silvery hue, slightly brown on the back, to a rich red-brown on the back speckled with grey, and a rich yellow, almost golden, tinge on the belly.

Plate XIX., fig. 2, is a full-size drawing of a specimen obtained for me by Mr. Travers, from the Maitai River, Nelson, and with which he furnished the following notes :—

"These fish appear at the mouth of the Maitai River usually in the early part of October, evidently from the sea; at what period they return to the sea I am unable to say.

"The migration beyond the influence of the tide does not take place immediately after the fish leaves the sea, for they evidently ascend and descend daily as far as the tide-way is felt, ascending with the flood and descending with the ebb, probably the better to prepare for their continuance in purely fresh water during the period of spawning. They occur in considerable shoals, and appear at first to prefer the shallower and slower-flowing parts of the river, basking in the sun on the shingle beds. They rise to various kinds of fly and moth, and are taken also with the worm as a bait. As they descend the river, they change colour from a dull silver grey below to a rich brown, assimilating, in this respect, to the colour of the river-bed. In the shoals the fish are of various sizes, from nine and ten inches to five and six in length."

Plate XVIII., figs. 4a and 4b, is the life-size drawing of the head of a specimen* that was obtained in the Hutt River, in January, 1870, at which season they were ascending from the sea in immense shoals, the females being gravid and swollen to enormous size.

They are found in most of the streams in the colony, and are highly esteemed as food, but have not the flavour of the true Trout.

The following table shows the actual dimensions of average full-sized

* Named *Coregonus*, by mistake on the plate.

specimens of the fish which are described in the foregoing paper, the specimens in each case being females full of roe :—

	R. Richardsonii.	*R. osmeroides.*	*C. Upokororo.*
Total length (inches)	3·7	7·0	10·3
To dorsal	2·2	4·0	5·5
To ventral	1·5	2·9	5·5
Dorsal to adipose fin	0·7	1·4	3·0
Length of head	0·7	1·5	1·8
Maxillary	0·2	0·8	0·7
To anterior margin of eye	0·1	0·5	0·6
Depth of body	0·5	1·2	2·3

ART. XXII.—*On a New Species of Fish,* Coryphænoides Novæ Zelandiæ: *Native name, Okarari.* By JAMES HECTOR, M.D., F.R.S.

(Plate XVIII., fig. 1.)

[*Read before the Wellington Philosophical Society, October* 22, 1870.]

IN August last, the fish which forms the subject of this notice was brought to me as a *Frost-fish,* to which rare fish, from its narrow body and silvery colour, it bears a general resemblance. It however belongs to a group more allied to that which includes the cod, and, from its having no caudal fins, to the family *Macruridæ,* and, from the absence of ridges on the skull, to the genus *Coryphænoides.* At the same time, it is distinct from any species described by Dr. Günther (*Fishes of Brit. Mus.,* Vol. iv., p. 395), by the position of the vent, which is set much further back than the commencement of the second dorsal fin.

The colour of the fish, when fresh, was silver grey, a little darker above than beneath, with a pale brown patch extending on each side from above the eye to the pectoral fin. The fins were all darker in colour than the body.

The eye is remarkably large in proportion to the size of the head. The iris of a pale bluish brown.

From under the jaw there is a long bifid barbel, as in the cod.

The teeth are in two series, the outer row set fine, and the inner long and recurved.

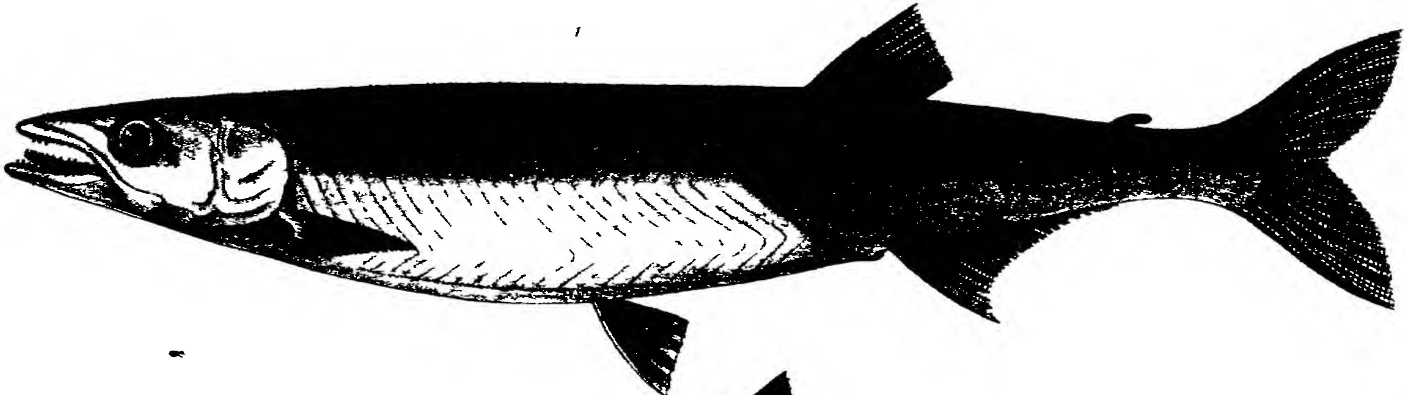
P. 12. V. 8. 1st D. 12. 2nd 102. A. 92.

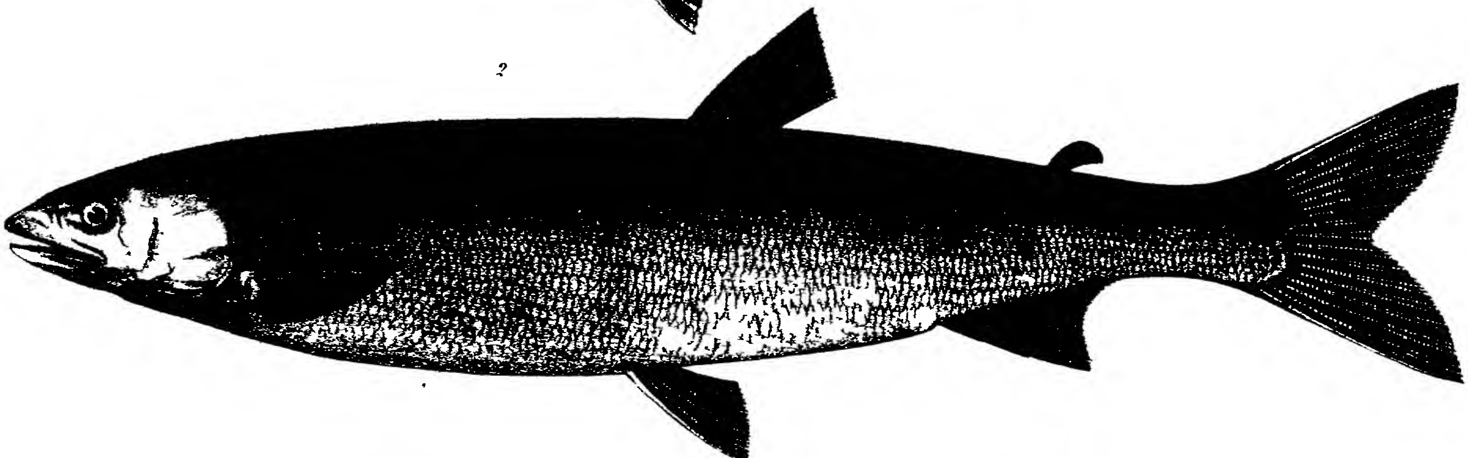
Only one mutilated specimen, now in the British Museum, appears to have been obtained in the Australian seas of any of the species of this genus, and as the specimen above described differs in a very marked manner from the figure and description of that fish given in Richardson's work, I think it must be undescribed, and therefore propose to call it *Coryphænoides Novæ Zelandiæ.*

Its length is 21 inches; height 2½ inches; thickness about ¾ inch.

The diameter of the orbit is nearly 1¼ inch; and the gape 1¾ inch long.

The only specimen yet obtained was caught off Ward Island, in Port Nicholson.

1


2


1 RETROPINNA OSMEROIDES, Hector 2 RETROPINNA OPCKORORO Hector

J. Buchanan del. et lith. Printed at the Govt. Lith. Press, by J. Earle

Art. XXIII.—*On the* Lepidoptera *of Otago.* By A. Bathgate.

[*Read before the Otago Institute, January* 11, 1870.]

The niggardliness of nature in her providing for New Zealand has almost become proverbial, and she has certainly been far from liberal so far as insects are concerned. We are rather gainers by this, for though many insects are beautiful and useful to man, the majority either subject us to petty annoyances, or are positively noxious. We may miss the "first white butterfly" among the signs of spring; but we are saved from finding the caterpillars in our cabbage. We have no wasps and few ants, and except, perhaps, mosquitos and sand-flies, in remote localities, and the great plague of the aphis, or blight as it is usually called, we are, compared with other countries, free from insect pests. This paucity is more remarkable when we consider how imported insects thrive. The common house-fly (*Musca domestica*) has been accidentally introduced, and is now spread nearly all over the country, driving out to a great extent the native blow-fly. Nevertheless, although the number of insects in Otago is small, there is a large and not unimportant field for study.

The value of the study of entomology is so universally admitted, that any remarks which I may make in support of it may seem trite in the extreme; but there is one circumstance which occurred in Otago that I cannot refrain from mentioning, where a slight knowledge of entomology would have been of service. Four summers ago, I saw a person's lawn covered over with branches, and, on asking the reason, I was told that it was to keep the hens from scratching up the grass, for doing which they had suddenly taken a fancy. I went and looked at the lawn, and found that it was full of grubs, which were eating the grass roots, and that the fowls were scratching the grass to get at these grubs, which were the larvæ of a small brown beetle belonging to the genus *Elateridæ*, that sometimes eat the grass roots to such an extent as to cause large patches of it to wither up as if scorched by fire; my friend, in fact, was taking some trouble to prevent the fowls rendering him a great service.

The elater I have seen in New Zealand bears a very close resemblance to one of the British species. I am unable to say whether it is exactly the same, but the likeness was so great as to suggest the idea that this insect might have been introduced with the grass seed. If I be correct in my conjecture, it would be a very strong argument (if any be needed) in favour of the urgent necessity for the introduction of British insectivorous birds. The starling, a few of which have, I think, been successfully acclimatized here, would prove an inveterate enemy to these grubs. The grub I have referred to is not the only pest of the kind with which we have to contend, for the larvæ of the crane-fly, of which we have a representative in Otago, are also addicted to similar pursuits.

I shall give another example, which shows that it sometimes requires a little observation to know our insect friends from our insect foes. One year, when the hop-aphis was very destructive in Kent, the Kentish folks noticed great numbers of lady-bird beetles on the hops, so they immediately concluded that they were the origin, or at least, partially the cause of the evil, and destroyed numbers of them. This was, however, far from being correct, for the lady-birds live on the real culprits, the aphides. I mention this fact because the aphis is already a nuisance here, and because there is also a lady-bird which I have seen on two different occasions in the act of sucking a juicy aphis. This pretty little lady-bird is the only representative of the *Coccinellida* I have observed in Otago, and it seems to be widely distributed over the province. It is little more than half the size of the commonest British variety (*Coccinella septem punctata*), is coloured black, and has twelve orange spots on the elytræ, and two on the thorax.

We have many other insects which are injurious, though their effects may not be so apparent, or so widely spread, as is the damage caused by those I have just mentioned. Thus, we have beetles which are destructive to the timber, and others which injure the foliage of our trees. Indeed, I have seen some willow trees almost completely denuded of their leaves by a little brilliant green beetle. The grasshopper, too, which in some parts of the province swarms in countless numbers, must devour a large quantity of valuable grass.

There are also several insects of very strange appearance to be found in Otago. One of these is the "walking-stick" of the colonists, which is an apterous insect, belonging to the order *Orthoptera*, and the tribe *Phasiuma.* It derives its name from its extraordinary resemblance to a twig; it is usually about an inch and a half long, but one specimen which I have seen was nearly six inches in length; again, the pupa of the native cicada, or, as it is commonly called, the singing locust, presents a very remarkable appearance. It is found in the ground, is active, and in form greatly resembles the perfect insect, only it is without wings, and is provided with a pair of huge claws like those of a lobster, which give it an exceedingly ferocious appearance; but whether they are used for carnivorous purposes or only for cutting the roots of plants I do not know. The pupa works its way out of the ground before the cicada bursts forth, and the empty cases may frequently be observed sticking to a tree or post. The sharp chirruping noise made by the perfect insects must be familiar to all. The Otago cicada has a peculiarity which is noticed in the variety common in the south of Europe by an old Greek poet, and which is, that these loquacious gentlemen "all have voiceless wives."

I have never been able to meet with a classified list of New Zealand insects, and whether or not such a thing exists I am unable to ascertain. If a list has ever been published, I have no doubt of its being a very imperfect one. Hochstetter mentions that there are 215 genera, including 265 species,

of insects found in New Zealand, but I am sure that must be very much under the number, because he puts the *Lepidoptera* down at fifty-five, and I feel certain that that order has many more species.

There are sixty-six species of British butterflies, while the moths number nearly two thousand. I have myself observed in Otago alone, four or five species of butterflies, and more than twenty species of moths, but as to the numbers I have captured I cannot speak positively, for my entire collection has unfortunately been recently completely destroyed.

Of the butterflies, the most striking, and one of the commonest, is a representative of the *Vanessidi*. This butterfly is almost an exact facsimile of the English *Atalanta*, or red admiral, which it resembles both in the deep black grounding and brilliant scarlet bands of the upper side, as well as in the beautiful pencilled tracery of browns and greys underneath. It is the earliest of our butterflies; I have observed an early specimen flitting about among the spring flowers on a bright day towards the end of August or beginning of September. On catching any of these, the wings generally present a very torn and tarnished appearance, so that I have little doubt they hybernate. There are probably two broods of them in each year—one leaving the chrysalis about midsummer, and the other in the autumn. I do not know upon what the larvæ of this butterfly feed, nor, indeed, do I know the food of the larvæ of any of the New Zealand *Lepidoptera*, for I have never reared them; but I have never seen any caterpillars which at all resemble those of the same family found in Britain.

The genus *Pieris*, which includes some of the commonest British species, is, so far as I know, without a single New Zealand representative. Another butterfly common in the neighbourhood of Dunedin is one which, I think, belongs to the *Satiridi*, some members of which family it greatly resembles on the upper side, though the under side has silvery markings, which in England are peculiar to the *Argynnidi*. I am, however, almost certain that there is a *Fritillary* to be found in Otago; for one day, in the interior of the province, I saw a butterfly, which, both by its general appearance and style of flight, led me to believe that it must be referred to that genus. Some of the species of these butterflies are so exceedingly local in their habits that we might have several forms, and yet they might not be discovered for a long time, even if there were many collectors.

There is another very pretty little butterfly which is not uncommon; it bears a strong resemblance to the small copper *Chrysophanus phlœas* of Britain, though it is rather larger. The genus *Polyommatus* has one, if not two, species; one resembles the *P. Artaxerxes*, with a tinge of blue, and the other has more blue, but whether these are distinct species or merely varieties, I cannot decide, even possibly it is only the difference of the sexes. These lively little butterflies are widely spread over the open grass lands, and numbers of them

may be seen during the summer, dancing with their peculiar jerky flight over plats of short grass by creek sides and in similar situations. I have now mentioned all the butterflies which I know of existing in Otago; they are few in number, but there must be several other species to be met with if they were to be searched for.

Of the moths of Otago, the commonest is a day-flier, which has black wings with white spots, the abdomen annulated with orange, and the antennæ pectinated. This moth is frequently mistaken for a butterfly. This, however, it is not, but a true moth, belonging to the family *Chelonidæ*. It is common all summer, and makes its first appearance in October. There is another representative of this family which I have met with, and which, though not so handsome as some of its British congeners, is one of the most brilliantly coloured New Zealand moths known to me. In appearance it greatly resembles the wood tiger (*Nemeophila Plantagenis*), is a strong flier, and difficult to capture, though, like the previous one, it also enjoys the sunshine. The larvæ are black hairy caterpillars, which do not seem to be at all particular as to what they eat, for they seem to devour indiscriminately the grass and other small herbage. I have seen them in the interior, in the neighbourhood of Hamilton and Hyde, where, in the early part of the summer of 1866, they were so numerous as to blacken the ground in places, especially where the shorter grass grew, at the sides of tracks or water races. There are probably two broods a year, for the moths from the early brood come out about the end of November and beginning of December. There is another moth common up-country which I have only noticed where spear-grass (*Aciphylla Colensoi*) abounded; it is remarkable more for its size than its beauty, for it is all of a light fawn colour. It is, however, the largest of the Otago moths I have seen, yet not very large, being only three inches across the wings. Whether the larvæ feed on the spear-grass, or on some plant which grows in the same places, I know not.

The *Geometrina* are pretty well represented. There is one insect in this family which is very common, and which is rather handsome though its colours are sombre, for its markings are pretty, and it is much larger than the majority of the moths of this group. It may be found by searching during the day in the corners of out-houses and in other dark places.

Our commonest moth in Otago is one belonging to the *Nocturna*, as it may be caught almost any summer night in great numbers by exhibiting a light. There may be, I think, two or three kinds of this moth, for I have seen specimens bearing a great family likeness, and yet showing great diversity in their markings; yet even among those I had in my possession, there were some specimens which I felt sure belonged to the same species, and yet the markings varied considerably.

The last moth I shall refer to is one belonging to the *Hepialidæ*, which

is very common about the end of October and beginning of November. It is of a reddish brown, with lighter longitudinal spots on the upper wings; the larvæ feed on the roots of grass, and the chrysalides I have found in great numbers in newly-turned grass land early in October. There is another form with two white longitudinal lines on the fore wings.

There is a moth which, though not a native of Otago, I shall bring under your notice, as it is one of the natural curiosities of New Zealand.* It is a native of the North Island, and its peculiarity is a disease in the larvæ state. Many of these are killed just before turning into the pupa form by a fungus which grows upon them, which is known as *Sphæria Robertsii.* I have seen a dried specimen, and it presented a very singular appearance, with the fungus nearly twice as long as the caterpillar, growing from the neck. It is called awoto by the natives, by whom it is eaten.

I observed in the *Otago Daily Times*, some little time ago, some extracts from a paper read by Mr. Travers before the Institute in Wellington, in which he stated that moths were very numerous in New Zealand. Whatever may be the case in the North, I do not think his remark would apply to Otago; at least, so far as my observation goes, I should say that, compared with Britain, the varieties of moths are few, although some species abound in very great numbers.

Before concluding, I shall offer a suggestion to the Institute, which I trust they will at least deem worthy of consideration. It is, that they should offer a prize for the best collection of some natural objects which may be decided on, and perhaps varied every year, the collections, or the best and rarest specimens, to be retained for the Museum; such prize to be competed for by the children attending the various schools in Otago. I think that a few pounds annually expended for that purpose would be well spent. As an instance of the probable good effect such incentives might produce, I may state that there is a well known school in the neighbourhood of Edinburgh, called Murchiston Castle, where for a long time it has been the custom to turn the attention of the boys to scientific studies, and that that school had the honour of educating both the first and second naturalists chosen to accompany the late Abyssinian expedition. And though few, perhaps, can earn their livelihood by such pursuits, yet they beget in all, habits of observation. But apart from any consideration of mere utility, by encouraging boys in such studies you open to them the doors of a boundless store of enjoyment. I know of few greater pleasures than

> "To wander forth, rejoicing in the joy
> Of beautiful and well-created things.
> * * * *
> To see and hear, and breathe the evidence
> Of God's deep wisdom in the natural world."

---

* It is to be found among the roots of rata trees in many parts of Otago and near Dunedin.—Ed.

II.—BOTANY.

Art. XXIV.—*Notes on the Botany of Certain Places in the Waikato District, April and May*, 1870. By T. Kirk.

[*Read before the Auckland Institute, June* 13, 1870.]

The extensive sand hills at the North Head of the Waikato River, are dotted over with a sparse vegetation of *Carex pumila*, *Spinifex*, *Desmochœnus*, and other common arenarean plants, with patches of *Cassinia retorta*, and tussocks of *Arundo conspicua;* in moist places *Euphorbia glauca* may be found, and about the margins of the shallow sand lakes and pools, *Limosella aquatica*, *Azolla rubra*, and the common European water-cress. At the South Head the sand hills occupy but a comparatively small space, and being for the most part but low, have become covered with a dense growth of manuka and other shrubs, mixed with various sedges and rushes; in the moister places, *Leptocarpus filiformis* attains the height of seven feet. On the sand hills near the Port, the European *Iris Germanica* is abundantly naturalized, while *Malva crispa* and many other introduced plants are plentiful amongst the deserted houses and by the road sides. A form of *Potentilla anserina*, scarcely different from the European plant, is most abundant at the foot of the hills; and in plashy places, *Callitriche Muellerii*, F. Sond, *Crantzia lineata*, and *Myriophyllum variæfolium* are common. The sea cliffs are garnished with *Arthropodium cirrhatum*, and in sheltered places, *Olearia albida*, *Myoporum lætum*, and a few other common shrubs are found, but the number of species is remarkably limited.

On the hills about Port Waikato, *Sporobolus elongatus* forms the chief herbage, in many places to the exclusion of all other grasses. Notwithstanding its extreme toughness, it is as closely cropped by cattle as if regularly mown, and from its hardiness and quick growth, forms a remarkably dense and elastic sward. The settlers call it "Chilian grass," and think highly of its value; it is however a true native of the colony, and is found from the North Cape to the Upper Waikato, where it is increasing from the depasturing of cattle and the steady spread of agricultural operations.

From Port Waikato southward to Waikawa the country is much broken, the crests of the low hills being chiefly covered with fern and the usual ericetal plants, and the valleys filled with luxuriant forest, differing from that in the north in the entire absence of kauri and tarairi; viewed from the crests of the

hills, the epiphytic form of *Griselinia lucida*, which was unusually abundant, had a remarkable effect, from the contrast of its bold glossy foliage with that of the rimu, tawa, or rata, upon which it chanced to be growing. It is but rarely that the genera *Hymenophyllum* and *Trichomanes* are seen, as they appear to be in these patches of forest; only a few of the commoner forms were observed, and those only in small quantity.

On the sand hills about Peringa and Whakawa, *Zoysia pungens*, a small growing native grass is abundant, forming a compact turf, and affording a large supply of succulent herbage to horses and cattle. Although this grass occurs in many localities, from the North Cape southwards, it is rarely found in so great abundance. *Astelia Banksii* occurs on the cliffs, evincing its decided preference for a maritime habitat. *Crantzia*, *Salicornia*, *Mesembryanthemum*, and other littoral plants occur here in profusion.

Ascending the river from Port Waikato, *Avicennia officinalis* and *Plagianthus divaricatus* are found for a short distance, but the extensive swamps and low lands which stretch to the vicinity of Tuakau, present but little of interest, except occasionally to the flax manufacturer; occasionally extensive patches of kahikatea are seen, and, on a large island opposite Mercer, are some fine specimens of the tarairi (*Nesodaphne Tarairi*, Hook. f.), the finest I saw in the Waikato. This handsome tree appears to attain its southern limit between Mercer and Rangiriri, thus exhibiting a very restricted range when compared with the tawa (*Nesodaphne Tawa*, Hook. f.), the only other member of the genus, and which, according to Buchanan, is found in the Province of Marlborough.

At Kohe-kohe, above Mere-mere, a solitary ngaio (*Myoporum lætum*), evidently planted, is pointed out by the Maoris as a "pakeha" tree; two stunted specimens were observed on abandoned native cultivations at Rangiriri. In the Waikato it appears to be confined to the coast, and flourishes only in situations exposed to the sea breeze. The puriri (*Vitex littoralis*) is not observed by the river side further south than about three miles above Mere-mere, although it is met with in several localities between the river and the coast; it is however decidedly rare in the Upper Waikato.

In places where the current is not too swift, a dense growth of *Typha latifolia*, *Scirpus lacustris*, and *S. maritimus*, is found at the foot of the bank and in the adjacent marshes; in shallow places in the river, *Myriophyllum variæfolium*, an undescribed *Potamogeton* allied to *P. zosteræfolius*, Schum., and a species with floating as well as submerged leaves, allied to *P. natans* and *P. heterophyllus*, are abundant. *Nitella Hookeri* often forms large patches, and in shallow gravelly places, *Zannichellia palustris* is occasionally met with; this appears to be a rare plant in the colony, having been previously collected on the east coast of the North Island only. The paucity of fluviatile plants in the Waikato is remarkable, although some allowance must be made

for the advanced period of the season at which these observations were made.

Several feeders empty themselves into the Waikato, more especially on its western bank; most of these are of tortuous course, running for many miles among the hills. A description of the chief features of the Opuatia Creek, which was explored for twenty-five miles from its mouth, may be taken as a general representation of those of other creeks. The first five or six miles passes through extensive raupo swamps, occasionally relieved by large patches of New Zealand flax and various sedges; on the margins of quiet reaches, *Riccia fluitans*, previously known as a New Zealand plant only in deep water in the Wairarapa Valley, is occasionally found, but is by no means common. Large kahikatea swamps were relieved by a dense undergrowth of various species of *Coprosma*, which, at this late period of the season, atoned for the absence of flowers by their brilliant show of berries of orange, purple, crimson, white, red, and jet black; the effect being enhanced by the immense panicles of snow-white berries of the ti (*Cordyline australis*), and, high above all, the bright red fruit of the kahikatea, which were produced in unusual abundance. *Asplenium australe*, Br., one of the few New Zealand plants which evince a decided geognostic preference, was abundant in marshy woods on the impure limestone through which the stream has forced its way. Alluvial ground along the entire course of the creek is covered with European docks, of so dense a growth that it is difficult to force one's way through them, and the common water-cress (*Nasturtium officinale*) is abundant; for some fifteen miles, the only fluviatile plants were the *Potamogetons* before mentioned. In the low woods, *Plagianthus betulinus*, one of the most ornamental trees in the flora, was common, but except on dry ground had lost most of its leaves. It deserves to be largely used for ornamental planting; in habit it is the best representative we have of the European birch, its foliage closely resembling the var. *laciniata* of that well known tree.

But the most remarkable feature was the immense abundance, in one or two localities, of a peculiar group of plants for the most part members of widely separated families, but agreeing in the production of minute, usually diœcious, flowers, and so closely similar in foliage, and often in ramification, as to be distinguished only with extreme difficulty in the absence of fruit. Acres were covered with a dense intertwined growth of *Panax anomalum*, *Pennantia corymbosa*, *Melicytus micranthus*, *Myrsine divaricata*, *Coprosma*, sps., *Epicarpurus microphyllus*, *Muhlenbeckia complexa*, and young states of *Elæocarpus Hookerianus*;—one of the most curious assemblages of plants similar in external appearance, but widely different in structure, that could possibly be met with.

The young leaves of *Panax anomala* have hitherto escaped notice; in this locality they were usually trifoliolate, and irregularly lobed and toothed, resembling those of *Melicope simplex*, but of more irregular form. They

are but rarely developed on old branches and never in connection with fruit.

At Tepakiruna, *Geranium sessiliflorum* is found in abundance on the pumice deposit by the river; this is probably the northern boundary of this interesting little plant, which had not previously been observed in the North Island. *Potentilla anserina*, and other plants of interest, were collected here. The open country in the vicinity is clothed with short-growing manuka and fern, largely mixed with an undescribed *Schœnus* allied to *S. pauciflorus*, and presents few plants of interest.

Whangape Lake is the habitat of many interesting plants. *Asperula perpusilla* attains here its northern limit, the usually littoral *Chenopodium ambiguum* occurs on its banks, *Potamogeton pectinatus*, only collected elsewhere as a New Zealand plant, near Napier, is abundant in the lake and in the Whangape Creek, as are the undescribed members of the genus already spoken of. *Elatine Americana* is not unfrequent, *Ruppia maritima*, usually confined to muddy beaches and salt-water ditches, is common, as is *Zannichellia palustris*; *Scirpus fluitans*, L., has not been found elsewhere in New Zealand; a *Pilularia*, with solitary fronds, is found on the margin of the lake, as well as in deep water, but good specimens have not yet been collected, and the genus has not at present been found elsewhere in the colony. *Isoëtes Kirkii*, Braunn, originally discovered here, forms a compact turf at the bottom of the lake, whilst charads of several species are abundant,—amongst them *Chara fragilis*, Desv., var. *C. australis*, R. Br., and *C. gymnopitys*, A. Br., are additions to our flora, as is an interesting minute plant, an undescribed *Ranunculus* of abnormal form, having four sepals and four petals, with spathulate leaves, and which formed matted patches in water of one to six feet in depth.

In the adjacent forest, the elegant *Metrosideros Colensoi*, with its weeping branches, clothed many of the tallest trees; when in flower, in December and January, it must present a charming sight, the rose-coloured flowers being borne on the extremities of its slender pendulous shoots. It would be a striking addition to the lawn or shrubbery if grafted on the rata or pohutukawa, and treated as a weeping tree. A *Fuchsia*, of sub-scandent rambling habit, was found here, but without flower or fruit; it is, perhaps, a form of *F. Colensoi*. *Myosotis Forsteri* occurred sparingly. *Asplenium australe* was collected of unusual luxuriance, some of the fronds being six feet high. Occasional specimens of the kauri were observed, but it is decidedly rare.

Waikare Lake is of irregular shape, and about eight miles long by three in width. It presents a marked contrast to Whangape Lake, in the comparative absence of lacustrine vegetation. The only representative of the charads was *Nitella Hookeri*, which occurred in large masses; the undescribed *Ranunculus*, already referred to, was abundant, but nowhere to be seen in flower. The maritime plants, *Scirpus maritimus*, *Ruppia maritima*, *Leptocarpus*

filiformis, were abundant, together with *Selliera radicans*, Cav., at the east end of the lake. *Isoëtes Kirkii* occurred in scattered patches in many parts of the lake, but was nowhere so abundant as at Whangape, nor did it make any approach to covering the bottom in those places where it grew; this is probably owing to the shifting sandy nature of the bed of the lake. The uliginal vegetation is similar to that of Whangape Lake.

The Waihi Lake is smaller than either of those just described; it has, however, a more copious vegetation than either. The very imperfect examination made of this lake, exhibited *Elatine Americana*, and most of the plants previously collected, together with an undescribed *Cladium*, with a much branched drooping panicle and long sheathing bracts, but the specimens were too far advanced to admit of an accurate diagnosis being drawn. A slender *Utricularia*, with weak stems two feet long, much divided capillary leaves, and rather large bladders on the leaves, was observed in several places at the bottom of the lake, but, of course, without fruit or flower at this season. It may prove to be a form of *U. protrusa*, Hook., originally discovered by Mr. Colenso in the Bay of Plenty, and which has not been found elsewhere.

Tetragonia expansa, usually confined to the vicinity of the sea, occurred by the marshes, and as an abundant weed on native cultivations; nearly every specimen was proliferous, a phenomenon I have not before noticed in connection with this plant.

At Taupiri, Rangiriri, and other places, the false acacia (*Robinia pseudoacacia*) is abundantly naturalized; it already forms coppices in many localities, and from its great durability is likely to prove serviceable for fencing purposes. The ordinary cultivated fruits, the fig, peach, vine, Kentish cherry, strawberry, raspberry, and tomato, are abundantly naturalized in many localities; the tobacco and thorn-apple (*Datura stramonium*) are occasionally met with, and *Navarretia squarrosa*, Hook. and Arn., is plentiful at Ngaruawahia, whilst the vicinity of every township and military post is marked by a large number of exotic grasses and viatical plants, one of the most common being *Lepidium ruderale*, a littoral plant which has, of late years, spread largely over the interior of the British Islands, and is increasing rapidly in this colony.

Above Ngaruawahia the current of the Waikato becomes much more rapid, consequently the vegetation at the margin of the river is greatly diminished in quantity, forming a marked contrast with that of the sluggish Waipa, which is fringed with a dense margin of uliginal and paludal plants. Approaching Hamilton, the river runs between high banks, clothed with *Weinmannia racemosa* and other shrubs, mixed with luxuriant clumps of wharaekie (*Phormium Colensoi*); in fruit this plant is easily distinguished from *P. tenax* by its twisted and rounded capsules, which are invariably pendulous, never erect and angled as in *P. tenax*. The fibre is also much weaker, in fact,

worthless to the manufacturer, but the undressed leaf is split into narrow strips by the natives for fishing nets, which are said to last longer than those made from the ordinary swamp flax.* The wharaekie is occasionally to be seen planted in Maori cultivations, both in the Waikato and Thames districts; it is much more abundant in the Upper than in the Lower Waikato, its favourite habitat being the faces of moist banks and cliffs.

At the Tamahore narrows, *Dracophyllum strictum* attains its northern limit, and from its numerous panicles of white flowers, forms an attractive object. At Cambridge, *Microseris Forsteri* was collected in abundance; *Zoysia pungens*, a low-growing grass usually confined to littoral situations, formed a dense sward in many places, and afforded a large amount of short succulent herbage, which was closely cropped by sheep and cattle; a few fragments of other grasses, apparently referable to the maritime *Glyceria stricta* and *Poa*, sp., were collected here, but in too advanced a stage to admit of identification.

Art. XXV.—*On the Occurrence of Littoral Plants in the Waikato District.* By T. Kirk.

[*Read before the Auckland Institute, June* 13, 1870.]

The frequent occurrence of several species of maritime plants in the Waikato District, far beyond the present range of tidal waters, appears to call for special remark from its important geological bearings. Dr. Hochstetter was, I believe, the first to advance the theory, "that the whole Middle Waikato basin was but recently a shallow arm of the sea or a far extending estuary." The accuracy of this opinion has however been impugned; it may therefore be advisable to recapitulate the maritime plants observed in and about the river and adjacent lakes and marshes.

Tetragonia expansa,—chiefly as a weed in native cultivations.

Apium filiforme,—woods by the Opuatia.

Selliera radicans, Cav.,—Waikare Lake. Has been found by the "Lower Waitaki River, Otago, apparently far from the sea."

Chenopodium glaucum, L., var. *ambiguum*,—on the shores of Whangape Lake.

Ruppia maritima, L.,—in Whangape, Waikare, and Waihi Lakes.

Leptocarpus simplex, A. Rich,—Waikare Lake. This occurs in a solitary locality in the North, a short distance only from the present reach of tidal water, and in small quantity.

Scirpus maritimus, L.,—from Waikato Heads to a few miles above Hamilton; abundant in all the lakes and marshes; also in the Waipa.

Zoysia pungens, Willd.,—Cambridge, abundant.

* The above is written from personal observation of this plant in the North only. It is said to produce a fibre of high quality in the South Island.

specially mentioned, I am not aware of the occurrence of any of foregoing beyond the reach of tidal waters.

No mention is made in the foregoing list of two or three littoral plants of doubtful identification, or of a few species, such as *Potamogeton pectinatus* and *Zannichellia palustris,* which are found indifferently in fresh or brackish water in Europe, but are of extreme rarity in New Zealand, and occur in the Waikato in company with known littoral species; and it should be remembered, that the advanced period of the season at which these observations were made was unfavourable for field work, as in their decaying state several of the smaller growing kinds were doubtless overlooked in some of the localities visited, and other species may have escaped notice altogether.

It is readily admitted that littoral plants may occasionally be found in inland situations from accidental causes, but in the present case the number of species, and the wide area over which they collectively extend, afford forcible proof that the cause of their growth must be found in the district having been formerly a shallow estuary, probably connected with the Frith of the Thames. Bearing in mind, that with each rising of the river the current at first runs swiftly into the lakes of Lower Waikato *from* the river, instead of from the lakes *into* the river, a ready explanation is afforded of the way in which these littoral plants have become established there. It is difficult to imagine that a plant of salt marshes, as *Scirpus maritimus,* could be carried from the mouth of the river, against a rapid current, for a distance of one hundred miles along its banks, and diffused over the fresh water lakes and swamps of a large extent of country besides. It is easy of comprehension how, if introduced from the Frith of the Thames, it would become established in the marshes, etc., on the retirement of the river to its present bed, and carried downwards until it again met the tidal water on the western coast.

There can be little doubt that a careful examination of the country between the Frith of the Thames and Middle Waikato, would result in the collection of additional evidence on this interesting subject.

Art. XXVI.—*On the Flora of the Isthmus of Auckland and the Takapuna District.* By T. Kirk.

[*Read before the Auckland Institute, August* 8, 1870.]

PART I.

In this paper it is intended to briefly delineate the Flora of the immediate vicinity of Auckland, so far as regards the Phænogams and higher orders of Acrogens. The lower Acrogens and the Thallogens will, it is hoped, form the subject of a subsequent paper.

The district is divided by the Waitemata into two parts, the well known Isthmus of Auckland, comprising the City of Auckland, with the towns of Onehunga and Panmure, and Takapuna, or the North Shore, which includes the site of the pretty town of Devonport.

The Isthmus of Auckland comprises an area of about 30,000 acres, its extreme length being about eleven miles, from the Whau Creek to the Tamaki, and its extreme width rather more than six miles. On the north, east, and west, it is bounded by the Waitemata, the Tamaki Creek, and Whau Creek, with the exception of a portage, less than two miles in length, from the Whau Creek to Motu Karaka on the Manukau; and the still shorter portage between Halswell's Creek on the Tamaki, and Fairburn's Creek on the Manukau. On the west, it is bounded by the Manukau from Motu Karaka to Fairburn's Creek, a distance of ten miles, not making allowance for the indentations of the shore. Thus, with the exception of about three miles, it is bounded by water.

The Takapuna District comprises that part of the North Shore extending from the North Head of the Waitemata to Lucas' Creek, and from the head of Lucas' Creek to Omangia Bay on the outer coast. It is roughly triangular in shape, and, with the exception of less than six miles from the head of the creek to Omangia Bay, is bounded by the sea. Its area is about 13,000 acres.

The entire area thus comprises about 43,000 acres, no part of which is more than eight miles in a direct line from Queen-street wharf.

Both districts belong to the tertiary formation, and are composed of stiff clays, marls, and sandstones. On the Isthmus this has been pierced by numerous volcanoes, the lava streams and ashes from which cover fully two-fifths of its area, affording a soil of great fertility. Amongst the lava streams are considerable depressions, which, from the drainage becoming obstructed, form extensive swamps, in some cases dried up during the summer. The hills are volcanic cones, of low elevation, the highest being Mount Eden, which is only 642 feet above the sea level. In the Takapuna District volcanic action has been confined to the North Head, Mount Victoria, the western shore of Shoal Bay. The Pupuke Lake fills the bed of a crater about two-thirds of a mile in diameter, and has a depth of twenty-eight fathoms. The highest point is Mount Victoria, which is under 300 feet.

Nearly the whole of the Isthmus has been brought under cultivation,* although here and there patches of clay land, or unusually rough portions of a lava stream, yield merely a sparse return of native grasses, with a large number of introduced plants; these are, however, rapidly decreasing, and from the almost entire destruction of the clumps of bush that formerly clothed the gullies, and the scrub that concealed the ruggedness of the scoria, indigenous

---

* The population of the Isthmus is about 23,000.

plants exist even under less favourable circumstances than in an agricultural county in England, for the friendly shelter of hedge-rows and patches of coppice is almost unknown. In the Takapuna section, the unreclaimed clay lands have been so frequently fired, that the natural vegetation over large areas is restricted to stunted tea-tree and similar small shrubs, with a few grasses and introduced plants, the soil itself becoming deteriorated in an increasing ratio with each successive burning.

The scoria cones of the Isthmus have become covered with a dense sward of introduced grasses and small forage plants, amongst which a few native plants, as *Carex breviculmis*, *Ranunculus australis*, *Danthonia semi-annularis*, and others, still maintain their existence; in rough places, if at all sheltered, *Doodia caudata*, *Adiantum æthiopicum*, and *A. hispidulum*, are usually found, and appear to flourish with as great vigour as when on the stiff clays. Another interesting fern, *Gymnogramme leptophylla*, is occasionally observed on bare places, but from its small size is easily overlooked. *Scleranthus biflorus* forms patches amongst the introduced grasses, varied by occasional masses of *Acæna sanguisorbæ* and *A. Novæ Zelandiæ*, contrasted with solitary plants of *Vittadinia australis*. Numerous ferns and low-growing plants are found amongst the blocks of scoria which form the lava fields in all directions, and, where the shrubs and small trees have been preserved, these exhibit a luxuriance of growth for which one is altogether unprepared. *Polypodium Cunninghamii* frequently produces fronds over twelve inches in length, *Hymenophyllum Javanicum*, and *Trichomanes humile*, are often found in the most luxuriant state. The same remark applies, in an equal degree, to the shrubs and trees found in these seemingly unfavourable habitats; *Tetranthera calicaris*, *Griselinia lucida*, *Brachyglottis repanda*, *Alectryon excelsum*, *Panax Lessoni*, are abundant, and attain their usual stature and bulk. This luxuriance of growth in such an unpromising locality is a striking proof of the great amount of moisture in the atmosphere of the district. Taking 100 to represent saturation, the mean for Auckland is found to be 75; only two localities in the colony are known to give higher means, viz., Taranaki and Hokitika, for which the figures are respectively 80 and 90.

Astelia Solandri occurs frequently on the rocks, and is usually accompanied by by *Peperomia Urvilleana;* more rarely, *Astelia Banksii* is found in similar situations. *Cheilanthes Sieberi* and *Nothochlæna distans* are abundant upon exposed rocks, as are *Pellæa falcata* and *P. rotundifolia* in sheltered rocky places; while *Asplenium flabellifolium* in many localities lines every crevice with a drapery of the tenderest green.

The undulating clay hills and gullies are mostly clothed with low-growing tea-tree and *Pomaderris ericifolia*, varied by clumps of fastigiate *Dracophyllum squarrosum*. *Cordyline Pumilio*, *Lycopodium densum*, and *Phylloglossum Drummondii* are to be found in all suitable localities, and in wet places,

Drosera binata, *Lycopodium laterale*, and *Gleichenia hecistophylla* are abundant; the lower parts of the gullies are usually swamps filled with raupo, and edged with a varied growth of sedges and other uliginal plants, amongst which *Isachne australis* often occurs in abundance; the slopes are often clothed with low scrub, chiefly composed of the commoner heathworts, *Coprosma lucida*, *Cordyline Banksii*, etc.

Conspicuous in the patches of bush still remaining are *Tetranthera calicaris*, *Vitex littoralis*, *Metrosideros robusta*, *Nesodaphne Tawa*, *N. Tarairi*, *Leptospermum ericoides*, *Myrsine salicina*, *M. australis*, *Persoonia Toro*, *Knightia excelsa*, *Elæocarpus dentatus*, *Hedycaria dentata*, *Dammara australis*, with many other fine species, accompanied by the chief characteristic undergrowth of the northern forest, *Alseuosmia macrophylla*, *Coprosma grandifolia*, etc, and many small ferns. *Astelia Solandri*, *Pittosporum cornifolium*, *Dendrobium Cunninghamii*, *Earina mucronata*, and *E. autumnalis* are commonly epiphytic on the larger trees, *Tmesipteris Forsteri* is epiphytic on the stems of *Cyathea medullaris*, *C. dealbata*, and *Dicksonia squarrosa*.

On the coast the pohutukawa is still common, although all specimens sufficiently large for the purposes of the ship-builder have long since been removed, except at the Pupuke Lake, where some noble examples are yet to be seen. *Astelia Banksii* is abundant in sheltered places on the cliffs, and, in some localities, the renga-renga (*Arthropodium cirrhatum*), makes a fine display. *Crantzia lineata*, *Paspalum distichum*, *Triglochin triandrum*, *Chenopodium ambiguum*, and *Salicornia indica* are common in salt marshes and mud flats, whilst most of the ordinary littoral plants may be found in the varied habitats afforded by a coast line of fully sixty miles, making due allowance for the indentations and windings of the shore.

The chief localities for plants of special interest are Waiatarua or St. John's Lake, the lava field near Mount Wellington, etc., the head of the Manukau, the Onehunga Springs, the Bishop's Creek, Coxe's Creek, etc., on the Isthmus; in the Takapuna section, the North Head, Pupuke Lake, and the deep gullies near Stokes' Point.

A few species appear to reach their ultimate range of distribution in this small area:—*Pomaderris elliptica* attains its southern limit at the Whau and Lucas' Creeks; *Acæna Novæ Zelandiæ*, *Corysanthes Cheesemanii*, *Astelia Hookeriana*, have not yet been observed south of the Tamaki; nor has *Phylloglossum Drummondii*.

Viola Lyallii, *Potentilla anserina*, *Myosotis Forsteri*, and *Carex inversa* apparently find here their northern limits, and are remarkably local.

The effects of the changed conditions of plant life incidental to agricultural progress, are chiefly exhibited in two directions,—(1.) the restriction of species once plentiful in the district, to narrow habitats, in some cases to a few individuals only, and conversely in the increase of a limited number of species;—

(2.) in the rapid diffusion of many introduced plants, followed under certain circumstances by a further displacement of indigenous forms. Contrary to popular belief, there is no evidence to show that the operations of the settler have entirely eradicated even a single species; although many forms once common in the district have become extremely local, and exist under widely altered conditions. This conclusion is not invalidated by the absence of several species,—*Colobanthus Billardieri*, *Spergularia marina*, *Plagianthus betulinus*, *Panax Edgerleyi*, *Griselinia littoralis*, *Loranthus tetrapetalus*, *Olearia albida*, *Celmisia longifolia*, *Ozothamnus glomeratus*, *Sapota costata*, *Veronica macrocarpa*, *V. parviflora*, *Aspidium coriaceum;* for although on various grounds they might reasonably be expected to occur in the district, they are, with one or two exceptions, also absent from wide adjacent areas both to the north and south. This conclusion is further supported by the fact, that notwithstanding the sameness of the conditions under which vegetation exists in this district, it yet affords a larger number of indigenous species than any similar area which has yet been examined.*

Although the Flora now under consideration is that of a very limited area, and has had the conditions of plant-life greatly modified, it may fairly be taken as representative of the Flora of the colony, and pre-eminently of that of the Northern Island, excepting in both cases the alpine and sub-alpine sections. More than 200 of the plants now enumerated are common to the extreme north and the extreme south, 350 are common to both islands, and rather less than 100 species are peculiar to the North Island. No species is absolutely circumscribed within its limits, although several of its members are extremely local. Compared with the number of Phænogams and Ferns comprised in the New Zealand Flora, its members are in the proportion of 1 to 2·8; separately, the Phænogams as 1 to 2·7, the Ferns and Fern allies 1 to 1·7. The number of species known to occur in an indigenous condition in the Province of Auckland is upwards of 800, of which considerably more than half may be collected in the immediate vicinity of its capital.

A comparison of the Floras of the chief centres of settlement in the colony would afford results at once interesting and instructive, but the materials for making a comparison of this kind have not yet been prepared. It is, however, highly probable that the Flora of the immediate vicinity of Wellington will prove even more typically representative of that of the entire colony, although less purely characteristic of the North Island. It may be expected to exhibit a somewhat larger number of Ferns, with a smaller number of Phænogams.

---

* Compare Buchanan's *Lists of Plants found in the Province of Marlborough, and in the Vicinity of Mount Egmont;* Lindsay's *Contributions to New Zealand Botany;* "The Botany of the Great Barrier,"—*Trans. N. Z. Inst.*, Vol. i.; "The Botany of the Thames Gold Field," "The Vegetation of the Neighbourhood of Christchurch," and "A List of Plants found in the Northern Part of the Province of Auckland,"—*Transactions*, Vol. ii.

On the other hand, the Floras of Christchurch and Dunedin will probably prove of a more local type, less rich in the number of species and especially deficient in the higher Acrogens.

In the following catalogue, the numerals prefixed are intended to represent the relative abundance of each species. The series employed is 1, 2, 3, 4, 5, 10, 15, 20. The first three are restricted to local species, represented by a few individuals, as *Spiranthes australis;* 4 and 5 are used for local species, represented by a larger number of individuals, as *Corokia buddleoides.* But it must be borne in mind that the varying conditions of vegetable life incident to a populated district, are constantly modifying the relative frequency of indigenous species.

CATALOGUE OF PHÆNOGAMS AND FERNS, &c.,

OBSERVED ON THE AUCKLAND ISTHMUS AND NORTH SHORE.

I.—DICOTYLEDONS.

15. Clematis indivisa, *Willd.*
5. „ fœtida, *Raoul.*
1. „ parviflora, *A. Cunn.*
15. Ranunculus plebeius, *Br.*
15. „ hirtus, *Banks and Sol.*
3. „ macropus, *Hook. f.*
10. „ rivularis, *Banks & Sol.*
    „ b. subfluitans.
3. „ acaulis, *Banks & Sol.*
5. „ parviflorus, *L.*, var. australis
10. Nasturtium palustre, *DC.*
15. Cardamine hirsuta, *L.*
    „ a. debilis
    „ b. corymbosa
3. „ stylosa, *DC.*
5. Lepidium oleraceum, *Forst.*
3. Viola Lyallii, *Hook. f.*
10. Melicytus ramiflorus, *Forst.*
10. Pittosporum tenuifolium, *Banks and Sol.*
5. „ crassifolium, *Banks and Sol.*
10. „ eugenioides, *A. Cunn.*
5. „ cornifolium, *A. Cunn.*
5. Stellaria parviflora, *Banks & Sol.*
3. Elatine Americana, *Arnott*
10. Hypericum japonicum, *Thunb.*
10. Plagianthus divaricatus, *Forst.*
10. Hoheria populnea, *A. Cunn.*
5. Entelea arborescens, *Br.*
15. Aristotelia racemosa, *Hook. f.*
15. Elæocarpus dentatus, *Vahl.*
10. Linum monogynum, *Forst.*
10. „ marginale, *A. Cunn.*
10. Geranium dissectum, *L.*, var. carolinianum
    „ a. pilosum
    „ b. patulum
    „ c. glabratum
15. „ microphyllum, *Hook. f.*
10. „ molle, *L.*
15. Pelargonium australe, *Willd.*, var. clandestinum
15. Oxalis corniculata, *L.*
    b. stricta
    c. microphylla
    d. ciliifera
10. Phebalium nudum, *Hook.*
10. Melicope ternata, *Forst.*
5. „ simplex, *A. Cunn.*
10. Dysoxylum spectabile, *Hook. f.*
3. Pomaderris elliptica, *Lab.*
20. „ phylicifolia, *Ladd.*
15. Dodonæa viscosa, *Forst.*
15. Alectryon excelsum, *Gærtn.*
10. Corynocarpus lævigatus, *Forst.*
20. Coriaria ruscifolia, *L.*
15. Carmichælia australis, *Br.*
10. Sophora tetraptera, *Ait.*
    „ b. microphylla
15. Rubus australis, *Forst.*
    „ b. schmidelioides
    „ c. cissoides
3. Potentilla anserina, *L. Cheeseman*
20. Acæna Sanguisorbæ, *Vahl.*

10. Acæna Novæ Zelandiæ, *Kirk*, n. s.
5. Quintinia serrata, *A. Cunn.*
10. Carpodetus serratus, *Forst.*
10. Weinmannia silvicola, *Banks & Sol.*
10, Tillæa verticillaris, *DC.*
15. Drosera binata, *Lab.*
20. „ auriculata, *Backh.*
20. Haloragis alata, *Jacq.*
15. „ tetragyna, *Lab.*, v. diffusa
5. „ depressa, *Hook. f.*
20. „ micrantha, *Br.*
5. Myriophyllum variæfolium, *Hook. f.*
3. „ robustum, *Hook. f.*
15. Callitriche Muelleri, *F. Sond.*
20. Leptospermum scoparium, *Forst.*
10. „ ericoides, *A. Rich.*
„ „ var.
5. Eugenia Maire, *A. Cunn.*
10. Metrosideros florida, *Sm.*
3. „ diffusa, *Sm.*
5. „ hypericifolia, *A. Cunn.*
5. „ robusta, *A. Cunn.*
10. „ tomentosa, *A. Cunn.*
15. „ scandens, *Banks & Sol.*
15. Myrtus bullata, *Banks & Sol.*
15. Fuchsia excorticata, *L. fil.*
15. Epilobium nummularifolium, *A. Cunn.*
„ b. nerteroides
15. „ rotundifolium, *Forst.*
5. „ glabellum, *Forst.*
10. „ "tetragonum," *L.*
15. „ junceum, *Forst.*
15. „ pubens, *A. Rich.*
5. „ Billardierianum, *Serin.*
15. „ pallidiflorum, *Sol.*
15. Passiflora tetrandra, *Banks & Sol.*
5. Sicyos angulatus, *Sol.*
10. Mesembryanthemum australe, *Sol.*
5. Tetragonia expansa, *Murr.*
5. Hydrocotyle elongata, *A. Cunn.*
3. „ Americana, *L.*
15. „ Asiatica, *L.*
3. „ pterocarpa, *F. Muell.*
3. „ Novæ Zelandiæ, *DC.*
10. „ moschata, *Forst.*
„ var.
5. Crantzia lineata, *Nutt.*
15. Apium australe, *Thouars*
15. „ filiforme, *Hook.*
3. „ leptophyllum, *F. Mueller.*
10. Daucus brachiatus, *Sieb.*
10. Panax crassifolium, *Dene & Planch*
15. „ Lessonii, *DC.*
15. Panax arboreum, *Forst.*
15. Schefflera digitata, *Forst.*
10. Griselinia lucida, *Forst.*
5. Corokia buddleoides, *A. Cunn.*
5. „ cotoneaster, *Raoul.*
5. Loranthus micranthus, *Hook. f.*
2. Viscum salicornioides, *A Cunn.*
10. Alseuosmia macrophylla, *A. Cunn.*
3. „ quercifolia. *A. Cunn.*
3. „ linariifolia, *A. Cunn.*
15. Coprosma lucida, *Forst.*
15. „ grandifolia, *Hook. f.*
3. „ Baueriana, *Endl.*
15. „ robusta, *Raoul.*
5. „ Cunninghamii, *Hook. f.*
5. „ spathulata, *A. Cunn.*
10. „ tenuicaulis, *Hook. f.*
5. „ "crassifolia," *Col.*
3. „ divaricata, *A. Cunn.*
5. „ acerosa, *A. Cunn.*
5. Nertera dichondræfolia, *Hook. f.*
3. „ Cunninghamii, *Hook. f.*
Galium tenuicaule, *A. Cunn.*
T. F. Cheeseman.
10. „ umbrosum, *Forst.*
15. Olearia furfuracea, *Hook. f.*
15. „ Cunninghamii, *Hook. f.*
10. „ Solandri, *Hook. f.*
5. Vittadinia australis, *A. Rich.*
15. Lagenophora Forsteri, *DC.*
5. „ petiolata, *Hook. f.*
15. Bidens pilosa, *L.*
20. Cotula coronopifolia, *L.*
20. „ australis, *Hook. f.*
5. „ minor, *Hook. f.*
15. „ minuta, *Forst.*
10. Cassinia leptophylla, *A. Cunn.*
5. Gnaphalium keriense, *A. Cunn.*
10. „ luteo-album, *L.*
20. „ involucratum, *Forst.*
20. „ collinum, *Lab.*
10. Erechtites arguta, *DC.*
10. „ scaberula, *Hook. f.*
10. „ quadridentata, *DC.*
15. Senecio lautus, *Forst.*
3. „ glastifolius, *Hook. f.*
15. Brachyglottis repanda, *Forst.*
5. Picris hieracioides, *L.*
15. Sonchus oleraceus, *L.*
15. Wahlenbergia gracilis, *A. DC.*
15. Lobelia anceps, *Thunb.*
10. Selliera radicans, *Cav.*
15. Gaultheria antipoda, *Forst.*
15. Cyathodes acerosa, *Br.*
15. Leucopogon fasciculatus, *A. Rich.*

15. Leucopogon Frazeri, *A. Cunn.*
10. Epacris pauciflora, *A. Rich.*
5. Drachophyllum latifolium, *A. Cunn*
10. „ squarrosum, *Hook. f.*
5. „ Urvilleanum, *A. Rich*
5. Myrsine salicina, *Hew.*
15. „ Urvillei, *A. DC.*
15. Samolus repens, *Pers.*
3. Olea Cunninghamii, *Hook. f.*
3. „ lanceolata, *Hook. f.*
15. Parsonsia albiflora, *Raoul*
15. Geniostoma ligustrifolium, *A. Cunn.*
1. Myosotis Forsteri, *Rœm. & Sch.*
20. Convolvulus sepium, *L.*
15. „ Tuguriorum, *Forst.*
5. „ Soldanella, *L.*
15. Dichondra repens, *Forst.*
15. Solanum aviculare, *Forst.*
15. „ nigrum, *L.*
3. Mimulus Colensoi, *Kirk*, n. s.
3. Gratiola sexdentata, *A. Cunn.*
10. Glossostigma elatinoides, *Benth.*
5. Limosella aquatica, *L.*, var. tenuifolia
20. Veronica salicifolia, *Forst.*
5. „ elongata, *Benth.*
10. Rhabdothamnus Solandri, *A. Cunn.*
15. Vitex littoralis, *A. Cunn.*
10. Avicennia officinalis, *L.*
15. Myoporum lætum, *Forst.*
6. Chenopodium triandrum, *Forst.*
10. „ glaucum, *L.*, var. ambiguum.
5. „ carinatum, *Br.*
5. Suæda maritima, *Dumort*
15. Salicornia indica, *Willd.*
15. Scleranthus biflorus, *Hook. f.*
20. Polygonum minus, *Hud.*, var. decipiens
20. „ aviculare, *L.*
15. Muhlenbeckia adpressa, *Lab.*
15. „ complexa, *Meisn.*
15. Rumex flexuosus, *Forst.*
10. Tetranthera calicaris, *Hook. f.*
10. Nesodaphne Tarairi, *Hook. f.*
10. „ Tawa, *Hook. f.*
15. Hedycarya dentata, *Forst.*
10. Knightia excelsa, *Br.*
5. Persoonia Toro, *A. Cunn.*
5. Pimelia longifolia, *Banks & Sol.*
5. „ virgata, *Vahl.*
15. „ prostrata, *Vahl.* var. sub-erecta
3. Santalum Cunninghamii, *Hook. f.*
10. Euphorbia glauca, *Forst.*
5. Epicarpurus microphyllus, *Raoul.*
15. Parietaria debilis, *Forst.*
10. Elatostemma rugosum, *A. Cunn.*
10. Peperomia Urvilleana, *A. Rich.*
15. Piper excelsum, *Forst.*
10. Dammara australis, *Lamb.*
10. Podocarpus ferrugineа, *Don.*
10. „ Totara. *A. Cunn.*
5. „ spicata, *Br.*
10. „ dacrydioides, *A. Rich*
10. Dacrydium cupressinum, *Soland.*
5. Phyllocladus trichomanoides, *Don.*

II.—MONOCOTYLEDONS.

10. Earina mucronata, *Lindl.*
10. „ autumnalis, *Hook.*
10. Dendrobium Cunninghamii, *Lindl.*
10. Bolbophyllum pygmæum, *Lindl.*
5. Sarcochilus adversus, *Hook. f.*
1. Gastrodia Cunninghamii, *Hook. f.*
15. Acianthus Sinclairii, *Hook. f.*
5. Cyrtostylis oblonga, *Hook. f.*
5. Corysanthes triloba, *Hook. f.*
5. „ oblonga, *Hook. f.*
3. „ macrantha, *Hook. f.*
3. „ Cheesemanii, *Hook. f.*
15. Microtis porrifolia, *Spreng.*
10. Caladenia minor, *Hook. f.*
10. Pterostylis Banksii, *Brown*
„ b. australis
5. „ graminea, *Hook. f.*
10. „ trullifolia, *Hook. f.*
5. Pterostylis puberula, *Hook. f.*
1. Chiloglottis cornuta, *Hook. f.*
15. Thelymitra longifolia, *Forst.*
3. „ pulchella, *Hook. f.*
1. Spiranthes australis, *Lindl.*, *T. F. Cheeseman*
15. Orthoceras Solandri, *Lindl.*
5. Prasophyllum pumilum, *Hook. f.*
5. Libertia ixioides, *Spreng.*
3. „ grandiflora, *Sweet.*
5. Freycinetia Banksii, *A. Cunn.*
„ var. picta
20. Typha latifolia, *L.*
15. Sparganium simplex, *Hud.*
5. Lemnor minor, *L.*
10. Triglochin triandrum, *Mich.*
Potamogeton "natans"
Zostera marina, *L.*

15. Rhipogonum scandens, *Forst.*
10. Cordyline australis, *Hook. f.*
10. „ Banksii, *Hook. f.*
5. „ Pumilio, *Hook. f.*
„ var.
10. Dianella intermedia, *Endl.*
5. Astelia Cunninghamii, *Hook. f.*
„ Hookeriana, *Kirk*, n. s.
5. „ "grandis" *Hook., f.*
15. „ Solandri, *A. Cunn.*
5. „ n. s.
15. „ Banksii, *A. Cunn.*
10. Arthropodium cirrhatum, *Br.*
15. Phormium tenax, *Forst.*
5. „ Colensoi, *Hook. f.*
5. Areca sapida, *L.*
5. Juncus australis, *Hook. f.*
10. „ maritimus, *Lam.*
10. „ communis, *E. Meyer*
„ var. hexandra
15. „ planifolius, *Br.*
20. „ bufonius, *L.*
10. „ Holoschœnus, *Br.*
5. Luzula campestris, *DC.*
15. Leptocarpus simplex, *A. Rich.*
3. Calorophus elongatus, *Lab.*, *T. F. Cheeseman*
20. Cyperus ustulatus, *A. Rich.*
15. „ tenellus, *L. fil.*
15. Schœnus axillaris, *Hook. f.*
15. „ tenax, *Hook. f.*
15. „ Tendo, *Banks and Sol.*
5. „ tenuis, *Kirk*, n. s.
10. Scirpus maritimus, *L.*
10. „ lacustris, *L.*
5. Eleocharis sphacelata, *Br.*
15. „ acuta, *Br.*, var. platylepis
„ „ var. ambigua
15. „ gracillima, *Hook. f.*
20. Isolepis nodosa, *Br.*
15. „ prolifer, *Br.*
15. „ riparia, *Br.*
3. Desmoschœnus spiralis, *Hook. f.*
15. Cladium glomeratum, *Br.*
20. „ teretifolium, *Br.*
5. „ articulatum, *Br.*
10. „ Gunnii, *Hook. f.*
15. „ junceum, *Br.*
10. „ Sinclairii, *Hook. f.*
10. Gahnia setifolia, *Hook. f.*
3. „ pauciflora, *Kirk*, n. s.
20. „ lacera, *Steud.*
15. Gahnia arenaria, *Hook. f.*
15. Lepidosperma tetragona, *Lab.*
10. „ concava, *Br.*
15. Uncinia australis, *Pers.*
10. „ Banksii, *Boott.*, var.
3. Carex inversa, *Br.*
15. „ virgata, *Sol.*
„ b. secta.
3. „ subdola, *Boott.*
10. „ ternaria, *Forst.*
10. „ testacea, *Soland*
15. „ lucida, *Boott.*
5. „ pumila, *Thunb.*
15. „ Forsteri, *Wahl.*
15. „ breviculmis, *Br.*
10. „ Neesiana, *Endl.*
10. „ dissita, *Sol.*
10. „ Lambertiana, *Boott.*
5. „ vacillans, *Soland*
20. Microlæna stipoides, *Br.*
10. „ avenacea, *Hook. f.*
5. Hierochloe redolens, *Br.*
3. Spinifex hirsutus, *Lab.*
10. Paspalum scrobiculatum, *L.*
10. „ distichum, *Burm.*
10. Panicum imbecille, *Trin.*
15. Isachne australis, *Br.*
5. Zoysia pungens, *Willd.*
10. Echinopogon ovatus, *Pal.*
10. Dichelachne stipoides, *Hook. f.*
15. „ crinita, *Hook. f.*
3. „ sciurea, *Hook. f.*
10. Sporobolus elongatus, *Br.*
20. Agrostis æmula, *Br.*
15. „ Billardieri, *Br.*
20. „ quadriseta, *Br.*
20. Arundo conspicua, *Forst.*
20. Danthonia semi-annularis, *Br.*
„ var. pilosa
„ var. setifolia
„ var. tenuis
5. Trisetum antarcticum, *Trin.*
4. Glyceria stricta, *Hook. f.*
5. Poa imbecilla, *Forst.*
20. „ anceps, *Forst.*
„ var. foliosa
„ var. densiflora
3. „ australis, *Br.*, vera.
„ var. lævis
3. Festuca littoralis, *Br.*
5. Bromus arenarius, *Lab.*
5. Triticum multiflorum, *Banks & Sol.*
5. „ scabrum, *Br.*

III.—CRYPTOGAMIA.

10. Gleichenia circinata, *Swartz*
,, b. hecistophylla
3. ,, Cunninghamii, *Hew.*
10. Cyathea dealbata, *Swartz*
10. ,, medullaris, *Swartz*
15. Dicksonia squarrosa, *Swartz*
10. Hymenophyllum Tunbridgense, *Sm.*
5. ,, multifidum, *Swartz*
5. ,, rarum, *Br.*
5. ,, dilatatum, *Swartz*
5. ,, Javanicum, *Spreng.*
10. ,, sanguinolentum, *Swartz*
10. ,, demissum, *Swartz*
5. ,, scabrum, *A. Rich.*
5. ,, flabellatum, *Lab.*
10. Trichomanes reniforme, *Forst.*
10. ,, elongatum, *A. Cunn.*
10. ,, humile, *Forst.*
3. Loxsoma Cunninghamii, *Br.*
15. Lindsæa linearis, *Swartz*
2. ,, trichomanoides, *Dryand.*
10. ,, Lessoni, *Bory.*
10. Adiantum hispidulum, *Swartz.*
5. ,, affine, *Willd.*
10. ,, æthiopicum, *Linn.*
15. Cunninghamii, H*ook.*
10. ,, fulvum, *Raoul.*
10. Hypolepis tenuifolia, *Bernh.*
1. ,, distans, H*ook.*
10. Cheilanthes Sieberi, *Kunze*
5. Pellæa falcata, *Br.*
10. ,, rotundifolia, *Forst.*
20. Pteris aquilina, *L.*, var. esculenta
15. ,, tremula, *Br.*
15. ,, scaberula, *A. Rich.*
5. ,, incisa, *Thunb.*
5. ,, macilenta, *A. Rich.*
5. ,, Endlicheriana, *Agardh*
10. Lomaria filiformis, *A. Cunn.*
20. ,, procera, *Spreng.*
,, var. b.
,, var. c.
,, fluviatilis, *Spreng.*
,, membranacea, *Col.*
,, vulcanica, *Blume.*
10. Lomaria lanceolata, *Spreng.*
10. ,, discolor, *Willd.*
10. ,, Frazeri, *A. Cunn.*
Doodia connexa, *Kunze*
15. ,, media, *Br.*
5. Asplenium obtusatum, *Forst.*
b. obliquum
c. gracile
15. ,, lucidum, *Forst.*
10. ,, flabellifolium, *Cav.*
10. ,, falcatum, *Lam.*
5. ,, Hookerianum, *Col.*
20. ,, bulbiferum, *Forst.*
b. laxum
15. ,, flaccidum, *Forst.*
var. b.
15. Aspidium Richardi, H*ook.*
var. marinum
3. Nephrodium Thelypteris, *Desv.*, var. squamulosum
5. ,, velutinum, H*ook.*
10. ,, decompositum, *Br.*
var. pubescens
10. ,, hispidum, H*ook.*
10. Polypodium australe, *Mett.*
5. ,, Grammitidis, *Br.*
10. ,, tenellum, *Forst.*
10. ,, rugulosum, *Lab.*
15. ,, pennigerum, *Forst.*
15. ,, rupestre, *Br.*
15. ,, Cunninghamii, H*ook.*
15. ,, pustulatum, *Forst.*
15. ,, Billardieri, *Br.*
4. Gymnogramme leptophylla, *Desv.*
10. Northochlæna distans, *Br.*
15. Leptopteris hymenophylloides, *Pre.*
15. Lygodium articulatum, *A. Rich.*
5. Schizæa dichotoma, *Swartz.*
10. ,, bifida, *Swartz.*
5. ,, fistulosa, *Lab.*
5. Ophioglossum vulgatum, *L.*
10. Phylloglossum Drummondii, *Kunze*
10. Lycopodium Billardieri, *Spreng.*
15. ,, densum, *Lab.*
15. ,, laterale, *Br.*
10. ,, cernuum, *L.*
15. ,, volubile, *Forst.*
10. Tmesipteris Forsteri, *Endl.*
1. Psilotum triquetrum, *Swartz*, *Capt.* F. *W. Hutton*
5. Azolla rubra, *Br.*

NATURALIZED PLANTS.

It has been already stated that one of the chief directions in which the indigenous flora has been affected by the operations of the settler, is in the displacement of many of its species by naturalized exotics. The extent to which these plants have become established is detailed in an "Account of the Naturalized Plants of New Zealand," published in the *Transactions of the New Zealand Institute*, 1869, which renders it needless to recapitulate the particulars here. A few general remarks on their diffusion in this district will serve as a fitting introduction to the following catalogue.

Many introduced grasses, trefoils, and medicks have formed patches of natural pasture, of considerable value, both on the scoria and clay; these are often improved by a mixture of native grasses, especially *Microlæna stipoides* and *Danthonia semi-annularis*, and, if the open lands were not so frequently burnt, this self-sown pasture would soon become general, and that on lands which can only be laid down in artificial pasture at a heavy expense. On waste places, and by road sides, an unsightly appearance is produced by the docks, camomile, mallows, and flea-bane, which everywhere take possession of disturbed soil. Of these, however, the flea-bane is commonly eaten by cattle when young.

A few plants have become pests on the light scoria soil; the sheep's sorrel and the white clover are almost ineradicable in gardens; *Phytolacca octandra* makes its appearance wherever soil is disturbed on the volcanic hills, or by the road sides in their vicinity, and forms large suffruticose bushes, whose spikes of black fruit produce a striking effect; *Amaranthus oleraceus* is usually associated with it, and less frequently the purslane, which enjoys a wider range of soil. The large moth-mullein rears its tall shafts on the North Head of the Waitemata and on Mount Eden, a marked contrast to the vegetation about it. It must have been an early introduction, as Hochstetter speaks of its occurrence in the former locality in 1858. *Œnothera stricta* appears to be confined to the volcanic hills, where it is usually plentiful.

In ordinary cultivated land, the milk-weed, *Euphorbia Peplus*, and several small speedwells are extremely troublesome, together with a few grasses, especially *Digitaria sanguinalis*, *D. humifusa*, and the canary-grass.

In every plashy place and moist gully on the Isthmus, *Lythrum hyssopifolium* is in abundance, affording a remarkable contrast to the paucity of this plant in its European habitats.

Black-berries, sweet-briars, and roses sometimes form large thickets, covered with the rampant *Senecio scandens*, from the Cape of Good Hope, or more rarely with the tropical *Dolichos lignosus*.

The dwarf centaury is abundant on open lands and in paddocks, forming a welcome addition to our native plants; *Aira caryophyllea* and *Prunella vulgaris* are frequently associated with it.

Lastly, while many species, as the water-cress, cat's-ear, furze, and the various docks, are perfectly irrepressible, others, as *Fredia olitoria*, *Lepidium sativum*, *Alchemilla arvensis*, etc., are content with little more than maintaining an unobtrusive existence.

Ranunculus acris.
,, repens.
Fumaria officinalis.
Nasturtium amphibium.
Barbarea præcox, *Br.*
Sisymbrium officinale.
Senebiera coronopus, *Poër.*
,, pinnatifida, *DC.*
Capsella bursa-pastoris.
Lepidium ruderale.
,, sativum.
Cochlearia armoracea.
Sinapis nigra.
,, arvensis.
Brassica rapa.
,, napus.
,, oleracea.
,, campestris.
Raphanus sativus.
Polygala myrtifolia.
Vitis vinifera.
Silene inflata, *Sm.*
,, quinquevulnera.
Saponaria vaccaria.
Lychnis githago, *Lam.*
,, flos-cuculi.
Stellaria media, *With.*
Cerastium vulgatum.
,, viscosum.
Polycarpon tetraphyllum.
Spergula arvensis.
Portulaca oleracea.
Hypericum humifusum.
Malva sylvestris.
,, rotundifolia.
Modiola multifida, *Meneh.*
Lavatera arborea.
Linum usitatissimum.
Geranium dissectum.
Pelargonium quercifolium.
Erodium cicutarium.
Podalyria sericea, *W.*
Ulex europæus.
Lotus corniculatus.
,, major.
Trifolium pratense.
,, medium.
,, glomeratum.
,, repens.
Trifolium procumbens.
,, minus.
Melilotus officinalis, *Willd.*
,, arvensis, *Willd.*
Medicago lupulina.
,, maculata.
,, denticulata, *Willd.*
Psoralea pinnata, *Willd.*
Indigofera viscosa, *Lam.*
Robinia pseudacacia, *Willd.*
Vicia sativa.
,, hirsuta.
,, tetrasperma, *Mœnch.*
Lathyrus odoratus, *Willd.*
Dolichos lignosus.
Acacia lophantha, *Willd.*
,, decurrens, *Willd.*, var. dealbata
Amygdalus Persica.
Prunus cerasus.
Spiræa salicifolia, *Willd.*
Rubus discolor, *W. and N.*
,, rudis, *Wrihe.*
,, Idæus.
Fragaria vesca.
Alchemilla arvensis.
Rosa micrantha, *Sm.*
,, rubiginosa.
,, canina.
,, indica.
,, multiflora, *Thunb.*
Lythrum hyssopifolium.
,, Græfferi, *Cust.*
Œnothera stricta.
Cucurbita citrullus.
,, sp.
Apium graviolens.
Petroselinum sativum.
Pimpinella saxifraga.
Fœniculum vulgare.
Daucus carota.
Pastinaca sativa.
Torilis nodosa, *Gart.*
Scaudix pecten-veneris.
Sambucus nigra.
Galium aparine.
Sherardia arvensis.
Fedia olitoria.
Erigeron canadensis.

Bellis perennis.
Anthernis arvensis.
" nobilis.
Achillea millefolium.
Matricaria inodora.
" chamomilla.
Chrysanthemum leucanthemum.
" segetum.
Senecio vulgaris.
" scandens.
Osteospermum moniliferum, *Willd.*
Cryptostemma calendulacea, *Br.*
Centaurea nigra.
" solstitialis.
" calcitrapa.
Carduus lanceolatus, *Gærtm.*
Silybum Marianum.
Lapsana communis.
Cichorium Intybus.
Hypochæris glabra.
" radicata.
Thrincia hirta, *Roth.*
Apargia autumnalis, *Willd.*
Tragopagon minor, *Fries.*
" porrifolius.
Helminthia ectrioides, *Gært.*
Sonchus oleraceus.
" arvensis.
Taraxacum dens-leonis, *Desf.*
Crepis vircus.
Xanthium spinosum.
Anagallis arvensis.
" var. cærulea
Vinca major.
Erythrea centaurium, *Pers.*
Lithospermum arvense.
Aselepias nivea.
Solanum nigrum.
" tuberosum.
" virginianum.
" indicum.
Physalis Alkekengi.
" peruvianum.
Capsicum annuum.
Lycopersicum esculentum, *Mill.*
Datura stramonium.
Nicotiana tabacum.
Lycium barbarum.
Verbascum thapsus.
" glabrum.
" blattaria.
Veronica arvensis.
" serpyllifolia.
" agrestis.
" Buxbaumii, *Ten.*
Digitalis purpurea.
Linaria elatine, *Mill.*
Verbena officinalis.
" bonariensis, *Willd.*
Orobanche Picrides, F. *Schultz*, var.
Mentha piperita, *Sm.*
" viridis.
" dentata.
Stachys arvensis.
Marrubium vulgare.
Prunella vulgaris.
Phytolacca octandra.
Plantago major.
" media.
" lanceolata.
Fagopyrum esculentum, *Manch.*
Rumex conglomeratus, *Murr.*
" viridis, *Sibth.*
" obtusifolius.
" crispus.
" acetosa.
" acetosella.
Chenopodium album.
" viride.
" murale.
Amaranthus oleraceus.
" Blitum.
" caudatus.
Euphorbia Peplus.
Ricinus Palma Christi.
Urtica urens.
" dioica.
Ficus Carica.
Canna Indica, *Rose.*
Iris Germanica.
Antholyza æthiopica, *Ker.*
Watsonia, sp.
Agave americana.
Allium vineale.
Asphodelus fistulosus.
Asparagus officinalis.
Alopecurus pratensis.
" agrestis.
Phleum pratense.
Phalaris canariensis.
Arrhenatherum avenaceum, *Beauv.*
Holcus lanatus.
" mollis.
Echinochloa crusgalli, *Beauv.*
Sectaria virdis, *Beauv.*
" italica, *Beauv.*
Agrostis vulgaris, *With.*
" canina.
Cynodon dactylon.
Digitaria sanguinalis, *Scop.*

Digitaria humifusa, *Pers.*
Anthoxanthum odoratum.
Aira caryophyllea.
Avena sativa.
Poa annua.
„ pratensis.
„ var. sub-cærulea
„ trivialis.
Eragrostis Brownii, *Kunth.*
Briza minor.
„ maxima.
Dactylis glomeratus.
Cynosurus cristatus.
Festuca elatior.
„ pratensis.
„ sciuroides, *Roth.*
Bromus erectus, H*ed.*
Bromus sterilis.
„ madritensis.
tectorum.
commutatus. *Schrœd.*
mollis, *Parl.*
racemosus, *Parl.*
arvensis, *Godron.*
patulus, *Parl.*
Ceratochloa unioloides, *Beauv.*
Lolium perenne.
„ italicum, *Braun.*
„ temulentum.
„ var. arvense
Triticum sativum.
Hordeum sativum.
„ murinum.
Lepturus incurvatus, *Trin.*

NOTE.—Where no authority is quoted in the above List of Naturalized Plants, the names are those given by Linnæus.

ART. XXVII.—*An Account of an Undescribed* Pittosporum *and* Loranthus, *in the Herbarium of the Colonial Museum, Wellington.* By T. KIRK.

[*Read before the Wellington Philosophical Society, August* 20, 1870.]

IN the course of an examination of the copious Herbarium of the Colonial Museum, several undescribed plants have come under my notice, two of which, at the request of my valued friend, Dr. Hector, I now attempt to describe.

Pittosporum Ralphii, Kirk. n. s.

A laxly-branched shrub, 8 to 12 feet in cultivation, with dark brown bark, young branches tomentose. Leaves alternate, coriaceous, tomentose beneath, especially when young, slightly narrowed and irregular at the base, obtuse or slightly acuminate, 2″–3″ long, on rather long slender petioles. Flowers in terminal 3–8-flowered umbels, peduncles $\frac{1}{2}$″–$\frac{5}{8}$″, tomentose, decurved in fruit; sepals linear, obtuse tomentose; petals narrow recurved; capsules rounded, 3-lobed and valved, never downy.

Hab.—Patea District,* *Dr. Ralph.* Allied to *P. crassifolium*, Banks and Sol., and to *P. umbellatum*, Banks and Sol., in its slender spreading branches, oblong leaves, and rounded capsules; from *P. crassifolium* it differs in addition, in the larger leaves, which are much less coriaceous and tomentose, never narrowed into the petiole, in the truly umbellate inflorescence, short peduncles, small smooth capsules and seeds; from *P. umbellatum*, in the tomentose leaves

* Since the above was written, Mr. W. J. Palmer, of Auckland, informs me that he has seen this plant on the Great Barrier Island.

and young shoots, small umbels, short peduncles, 3-valved capsules and large seeds. In habit and foliage it approaches *P. Huttonianum*, but that species has erect, axillary, pyriform capsules.

The preceding description is drawn partly from specimens in the Colonial Museum, and partly from recent cultivated specimens from gardens in Wellington. I am informed that it was brought from the neighbourhood of Patea by Dr. Ralph, whose name I have much pleasure in connecting with it.

It seems probable that this species is confused with *P. crassifolium* in the *Handbook*, but it is more closely allied to *P. umbellatum*. *P. crassifolium* is distinguished from all other New Zealand species by its large, usually solitary decurved fruit, and leaves gradually narrowed into the petioles.

Loranthus decussatus, Kirk. n. s.

In the "Account of the Botany of the Thames Gold Field," published in the *Transactions of the New Zealand Institute*, Vol. ii., p. 94, I have mentioned a *Loranthus* found without flower or fruit, and parasitic on *Quintinia serrata*, as likely to prove a new species. A careful examination of specimens of the same plant in the Herbarium, tends to confirm that opinion.

An erect, much branched, rigid shrub, young branches flattened, red; leaves erect, decussate, close set, ovate or elliptic, $\frac{1}{2}''$–$\frac{3}{4}''$ long, rarely deltoid; midrib not prominent, nerveless, fleshy, yellow, becoming red when dry; flowers axillary in opposite 2–4-flowered racemes, erect, shortly pedicelled, calyx with 4 minute teeth; corolla terete; petals linear, free, recurved at the tips; anthers linear.

Hab.—Cape Colville Peninsula, *T. K.* (on *Quintinia serrata*); Nelson, *H. H. Travers* (on *Fagus*).

Distinguished from other New Zealand species by its remarkable habit, small size and yellow foliage; most closely allied to *L. tetrapetalus*, Forst., from which it is separated by its racemed flowers. The parasite is often adherent to the supporting plant, by shoots of 3 or 4 feet in length.

I would take this opportunity of expressing my regret that greater attention cannot be paid to the Herbarium, on account of the limited resources at the command of the Director of the Museum. This collection of plants is unequalled in the colony for the extensive suites of specimens of rare and local plants, and it is to be deeply regretted that so rich a mass of material is not made fully available for the use of the student. The want of sufficient space for its due arrangement, and the impossibility under existing arrangements of affording the requisite time for its supervision, are serious drawbacks to its efficiency, alike to the scientific student and the settler seeking for general information. It is highly desirable that the requisite means should be supplied to place it on a proper footing, and to increase its value by the addition of

separate typical collections of drug-yielding plants, grasses and other agricultural plants, and others useful in the arts and manufactures, which, in addition to their phytological interest, would prove of the greatest value to the community as means of education and information.

Art. XXVIII.—*Notes on Certain New Zealand Plants not included in the "Handbook of the New Zealand Flora."* By T. Kirk.

[*Read before the Auckland Institute, September* 12, 1870.]

The object of this paper is simply to attract the attention of New Zealand botanists to the plants described therein, as most of them may be expected to occur in other parts of the colony, and it is desirable that their distribution should be clearly ascertained.

Hymenanthera latifolia, Endl.,
var. *Tasmanica.*

A dwarf bush or straggling shrub, 5 to 25 feet high. Leaves usually close set, obovate, narrowed into rather stout petioles, 2–3 inches long, distantly crenate, or serrate, finely reticulate on both surfaces; flowers in axillary fascicles, peduncles ¼″–⅜″ long, with two minute opposite bracts about the middle, erect or decurved; calyx lobes obtuse, petals more than twice as long as the sepals, the obtuse tips spreading, connective of the anther, with a fringed terminal membrane, involute on the edge, the dorsal scale linear, acute as long as the cells; fruit nearly globose, tipped with the remains of the style, purplish.

Var. *Chathamica* appears to differ from our plant only in the leaves being much narrowed at the base and more deeply serrated, and in the larger fruit.

In littoral situations. Tapotopoto Bay, *T. K.*, Mount Camel, *Mr. Buchanan*, Taranga Island, *T. K.*, Great Barrier Island, Flat Island, and Little Barrier Island, *T. K.*

This plant is abundant on the Little Barrier, where it attains the height of 25 feet, as an irregularly branched shrub. Mr. Buchanan showed me specimens of a small-leaved spinous form of this genus, collected in Wellington Harbour, which is probably referable to *H. crassifolia.*

Hibiscus diversifolius, Jacq.
H. Beckleri, *F. Muell.* H. Taylori, *Buchanan.*

A stout much-branched herb, 3–5 feet high, branches woody at the base; branches, petioles, and rarely the principal ribs of the leaf clothed with small prickles mixed with setæ. Leaves alternate, on stout petioles, petiole 2″–3″ long, lamina 2″–4″ cordate, or rounded cordate, obscurely 3–5-lobed, doubly serrate, hispid. Flowers in terminal elongated racemes, solitary or in

pairs, sessile or shortly pedicelled, bracts of the lower flowers large leafy, of the upper small, narrow linear, often deciduous, calyx coriaceous, lobes about 8 marginate, narrow, corolla 3″–4″ across, pale bright straw colour, with a dark maroon eye, capsule conical, valves rugose, when young, densely hispid, calyx lobes and bracts covered with harsh rigid hairs, which cause much irritation to the skin when the plant is handled.

Spirits' Bay and the adjacent district, *T. K.* Between the Bay of Islands and Mongonui, *Colenso.*

Also, in New South Wales, Queensland, Norfolk Island, and other islands in the South Pacific, South Africa, Mauritius, and Madagascar.

Mr. Colenso appears to have been its original discoverer in New Zealand.

The branches yield a coarse fibre.

Linum marginale, A. Cunn.

A perennial herb, with numerous erect or diffuse slender wiry stems, springing from a woody root stock. Stems 1′–3′ high, the upper part irregularly branched. Leaves ½″–¾″ long, linear-lanceolate, acute or obtuse, the lower ones falling before the capsules are matured. Flowers on long slender pedicels, pale blue. Sepals ovate-lanceolate, acute, with membranous margins. Petals nearly twice the length of the sepals. Styles united, their tips free, recurved. Capsule globose, "divided into 10 1-seeded cocci."

From the North Cape to Upper Waikato, New Plymouth, Wellington, *T.K.*

Mr. Buchanan informs me that a blue-flowered flax, found by Dr. Haast in the Canterbury Alps, is probably referable to this species.

Easily distinguished from *L. monogynum*, Forst., by its slender stems and shallow blue flowers.

It is probably common in suitable localities throughout the colony.

Common in Australia and Tasmania; closely allied to *L. angustifolium*, D.C., from which it differs in the united styles.

Apium leptophyllum, F. Mueller.
Helosciadium leptophyllum, *D.C.*

Stems slender, erect or diffuse, 3 inches to 1 foot in height, glabrous, faintly grooved. Leaves tri-pinnate, leaflets numerous, linear flat or almost filiform, lower leaves petiolate, petioles winged, sheathing, upper leaves sessile or nearly so. Umbels numerous, springing from the nodes, small, sessile, rays 2 or 3, partial umbels many flowered, flowers minute, pedicellate, involucral bracts 0, style short. Fruit small, ovate, with turgid ribs.

Kororareka, and other places at the Bay of Islands, *T. K.*, Kawau Island, *T. K.* Said to occur at Whangarei, but on insufficient authority.

Queensland, New South Wales, South America.

New Zealand specimens are much more slender than Australian; the segments of the leaves are wider and usually flat.

Olea apetala, Vahl.

An umbrageous shrub or small tree, 12–25 feet high, branches spreading, often tortuous; bark brown, in old specimens furrowed and corky; leaves opposite petioled, 3″–4″ long, 1″–2½″ wide, ovate, acuminate, very coriaceous, and of a deep glossy green, midrib prominent, veins distinct beneath; male flower not seen; female flower in stout racemes, 1″ to 1½″ long, spreading, 12–18 flowered, flowers in rather long pedicels; drupe obscurely deltoid, with rounded sides, apparently larger than in *O. Cunninghamii*, but only two or three old specimens were collected.

A much smaller tree than *O. Cunninghamii*, and of more spreading habit; by far the most striking of the New Zealand olives.

Rocky places near the sea. (Bream Head ?), Taranga Islands, Great Barrier Island, Nelson Island, Little Barrier Island, *T. K.*

Also, on Norfolk Island.

Gratiola latifolia, R. Br.

A sub-erect or prostrate herb, stems often rooting at the base, ascending 6″–12″ high, glabrous. Leaves sessile, ¾″–1″ in length, amplexicaul, broadly ovate or elliptic, obtuse, irregularly toothed, 3-nerved. Flowers on short peduncles, rather large, calyx ⅜″ long in fruit, segments broadly lanceolate, acuminate. Corolla white, large, ⅜″ long, white, tip shorter than the tube, anthers 2-celled, staminadia elongated, capsule ovoid, obtuse, inflated.

In marshy places. Puriri forest at Mangawhare, etc.

Also, in Tasmania, Australia, and extra-tropical South America.

This plant is considered by Bentham to be a form of *G. Peruviana*, *L.*, of which he appears to make *G. sexdentata*, A. Cunn., a variety. *G. latifolia* appears hitherto to have escaped the notice of botanists in New Zealand, and the points of difference are of sufficient interest to warrant my drawing the attention of botanists to it.

We have two forms of *G. sexdentata*, A. Cunn. (1.) A small erect form, with quadrangular stems and entire, obtuse, ovate, spreading leaves, flowers small; easily recognized by the pale green hue of the entire plant. (2.) A larger form, usually prostrate or sub-erect, with serrate, acute, leaves somewhat appressed, and large flowers; the whole plant of a purplish tint. Our forms are glabrous, but in Tasmania and Australia the various forms are "viscid-pubescent."

Potamogeton Poligonifolius, Pourr.
P. oblongus, *Viv.*

Upper leaves slightly coriaceous, floating 1″–3″ long, on rather long petioles, oblong-elliptical, lower leaves linear-lanceolate. Spike slender, densely flowered. Fruit small, obtuse, rounded on the back. Petioles always leaf-bearing, and longer than the leaves, stem creeping below. Fruit reddish brown.

Distinguished from *P. natans* by the rounded minute fruit, and the petioles being invariably leaf-bearing. A depauperated state occurs, in which the entire plant is less than three-quarters of an inch in height.

Ponds and marshes. Great Omaha, Papakura.

Abundant in Europe, but I am not aware of its existence elsewhere, except in New Zealand.

Scirpus fluitans, Linn.
Isolepis fluitans, *R. Br.* Eleogiton fluitans, *Luik.*
Eleocharis fluitans, *Hook.*

Stem floating or erect, branched, leafy, compressed, flower stems with a sheathing linear leaf at the base, spike solitary, terminal, ovate, few flowered, glumes obtuse, keeled, with membranous edges, outer glumes shorter than the spike, which they envelope, stigmas two, bristles 0, nut obovate, tipped with the base of the style.

Still waters, and margins of lakes, etc. Whangape, Waikare, and Waihi Lakes, Waikato; probably common elsewhere in New Zealand, but easily overlooked.

Europe, abundant.

ART. XXIX.—*On the Botany of the Northern Part of the Province of Auckland.* By T. KIRK.

[*Read before the Auckland Institute, October* 10, 1870.]

IN the "List of Plants" of this district, by Mr. Buchanan and myself, published in the *Transactions of the New Zealand Institute* for 1869, several errors and omissions were made, which it seems desirable to explain and correct. The list there given is a compilation from the notes of Mr. Buchanan's exploration of the district, in 1865-6, and from my own examination of certain points on its eastern side, in April, 1868. It was, however, prepared for publication by Mr. Buchanan under extreme pressure from other business, and under circumstances which precluded the possibility of a copy of the complete list being sent to me for examination, until after it had left the hands of the printer. As some of the errors and omissions which have thus crept in are of considerable importance, especially from a phyto-geographical point of view, I now purpose to supply the necessary corrections, and to add thereto the results of recent research in the district.

Before doing this, however, I am desirous of offering a few remarks, chiefly upon points of interest not noticed by Mr. Buchanan in his introduction. The district from Whangarei Harbour to the head of Doubtless Bay, may be roughly estimated at about eighty miles in length by fifty miles in width; of

the plants of fully one-third of this large district, say from Hokianga on the west coast southward to Mangawhare, we have scarcely any knowledge. From a little above the head of Doubtless Bay, a sandy peninsula connects the North Cape with the southern portion of the district, the length of the portion north of Doubtless Bay being about fifty-five miles, and varying in width from six miles at Ohora to about twenty-five between Cape Maria van Diemen and Cape Reinga. The entire district corresponds to the Northern area, and the Bay of Islands area as defined by Mr. Colenso. Its highest point is attained in the Maungataniwha range, and does not exceed 2800 feet, although I believe has been stated at various heights, from 2300 feet to 3000 feet. The country is varied with open fern or tea-tree land and heavy forest; much of the latter on the south-western side consisting of kahikatea. There are extensive swamps, some of which are choked with raupo and coarse sedges, whilst others support a large variety of moisture-loving plants. Grass lands are almost entirely wanting, although nearly half the native grasses have been collected in the district. The vegetation of the district, so far as the conditions of plant growth are concerned, may, with but few exceptions, be advantageously grouped as, (1.) Littoral, (2.) Ericetal, (3.) Paludal, (4.) Sylvestral. I do not propose to consider these groups in detail.

The chief distinctive features of the forest vegetation have been already pointed out by Mr. Buchanan. I need only remark that *Metrosideros tomentosa*, *Sapota costata*, *Pittosporum umbellatum*, *P. crassifolium*, and *Avicennia tomentosa*, belong entirely to the Littoral group, and form no portion of the forest flora, except in those places where the forest touches the sea-beach. The plants which chiefly give character to the northern forests are *Dammara australis*, *Nesodaphne Taraire*, *Vitex littoralis*, and *Phyllocladus trichomanoides*; *Vitex littoralis* forms the whole of the forest in several places on the western coast, and has a very different habit of growth to the generality of specimens of this tree on the eastern coast. Over the entire district, *Alseuosmia macrophylla* is to be met with, and in many places forms the whole of the undergrowth. All the species of this peculiar genus are found in the district, and at first sight appear to pass into each other by almost imperceptible shades of difference.

The following plants appear to be confined to this district:—*Pittosporum* ellipticum, Kirk, n. s., *P. reflexum*, (includes *Gilliesianum*, *Trans.* Vol. i., p. 143), *P.* pimeleoides, *Hibiscus diversifolius*, *Ackama rosæfolia*, *Drosera pygmæa*, *Haloragis tetragyna*, *Meryta Sinclairii*, *Ozothamnus lanceolatus*, Buchanan, n. s. (*Trans.* Vol. ii., p. 88), *Colensoa physaloides*, *Ipomœa tuberculata*, *Gratiola nana*, *Veronica diosmæfolia*, *V. speciosa*, *Cassytha paniculata*, *Thelymitra Colensoi*.

Of the above, eleven species are strictly endemic, and of those found in other countries the *Ipomœa* is the only species having a wide range. The

Hibiscus, Ipomœa, Cassytha, and *Veronica diosmæfolia* are the only forms that are not local in their habitats in the district.

The following plants are confined to the district, and to the Great and Little Barrier, or other outlying islands, but are not found elsewhere on the main-land :—*Hymenanthera Tasmanica, Pittosporum virgatum,* n. s., *Olea apetala,* Vahl., *Pisonia umbellifera,* Seem.

The following species are of more or less frequent occurrence in the district, but local elsewhere in the colony, and entirely confined to the North Island :—*Pittosporum Buchanani, P. Huttonianum, P. umbellatum, P. Kirkii, Hymenanthera crassifolia, Hibiscus Trionum, Apium leptophyllum, Pomaderris elliptica, P. Edgerleyi, Sapota costata, Atriplex Billardieri, Nephrodium Thelypteris, Prasophyllum pumilum, Doodia connexa, Nephrodium molle,* Desv., *Lycopodium Carolinianum, Metrosideros diffusa, Veronica elongata, Alseuosmia Banksii, Melicytus lanceolatus, Todea Africana, Nertera Cunninghamii, Australina pusilla, Cyathea Cunninghamii, Loxsoma Cunninghamii, Phyllocladus glauca.*

This list might be greatly extended, but, taken in conjunction with the short preceding sections, it exhibits a more remarkable series of lowland plants than could probably be found in any other part of the colony.

The following plants highly characteristic of the flora of the southern part of the colony, are sparingly represented in the district :—*Oxalis magellanica, Colobanthus Billardiari, Celmisia Munroi, C. longifolia, Olearea lacunosa, Vittadinia australis, Teucridium parvifolium, Fagus fusca, Hypolepis Millefolium.*

Nearly three-fifths of the entire number of plants found in the district are common alike to the Provinces of Auckland and Otago, but, although found over the same extent of country as to boundaries, they occur in very different ratios. *Corokia Cotoneaster* is found at the extremities of both islands, but there are spaces of many miles where this plant is entirely wanting, and in some of its habitats a very few specimens only are found; *Myrsine australis* is also found at both extremities of the island, and the traveller could not journey any great distance without meeting it in abundance. *Pteris esculenta* and *Leptospermum scoparium* are examples of plants abundant in every suitable locality between the North Cape and the Bluff.

Before leaving this part of the subject I will notice the peculiar variation of *Veronica diosmæfolia*—a plant already stated amongst the endemic plants peculiar to the district, as showing in the extreme North a characteristic feature of the *Veronicas* peculiar to the South, a feature the more remarkable, as in this district the genus exhibits a very slight degree of variation.

Veronica diosmæfolia is a handsome species, found in various localities from Cape Reinga to the Whangarei River, and is closely allied to some states of the southern *V. Colensoi.* It should be remarked that the first section of

the genus, as divided by Dr. Hooker, forms two groups, with scarcely an exception; one distinguished by entire leaves, the other by the leaves being variously serrated. But, as if purposely to show that the artificial characters employed by the systematist are, after all, mere matters of convenience, this distinct species exhibits two forms, one of which would, by the division just stated, be placed in the first group, the other in the second. In the first variety the leaves are close set, spreading, margined, *entire;* corymbs axillary, rarely terminal, flowers pale lilac, produced in great abundance, about October and November only. The second form exhibits the leaves close set, usually appressed in a greater or lesser degree, serrated or rather closely incised, as if simply cut with a pair of scissors, serratures and edges of the leaves margined; corymbs usually terminal, flowers white, produced more or less freely the whole year. The latter form was first observed by Dr. Hector and Mr. Buchanan, at the Bay of Islands, and is decidedly more local than the typical form. I have to express my thanks to Mr. D. Hay, for the opportunity of examining recent wild specimens collected by Mrs. Clarke.

The occurrence of *Veronica diosmæfolia* and *V. elongata* exhibits a curious phenomenon, absolutely without parallel in any other part of the colony—both species are the sole representatives in the district of their respective groups, both are endemic, and restricted to small areas; but the first, in general appearance and liability to a certain amount of variation, is a marked representative of the forms of the genus which are peculiar to the southern hemisphere; the other, equally in general appearance and fixity of character, represents the germanders and speedwells of the northern hemisphere.

The total number of species of flowering plants and ferns already collected in the district is under 550, and falls very far short of what may fairly be expected to occur. Further additions will be made to the extent of fully one-fourth as the district is worked up by competent observers.

I must own to a feeling of disappointment on reading Mr. Buchanan's remarks on the causes of plant variation in the colony. His extensive knowledge of the vegetation of its south and south-western portions especially, had led me to expect that he would throw some light on this obscure, but interesting, subject. His remarks on the influence of wind on plants have failed to convince me of the possibility of permanent variation being produced by its agency, which is purely mechanical, as it has been again and again proved that seeds from wind-dwarfed and prematurely aged trees, descended from others grown in the same locality for ages past, are capable in ordinary situations of producing trees of the normal type and luxuriance.

Dodonæa viscosa, which is cited by Mr. Buchanan as a (possible) instance of a species exhibiting an increasing tendency to variation as it recedes from its centre of maximum growth, does not in any way support that view, whether considered with regard to New Zealand alone, or to the numerous countries in

which it is found. The causes of variation in the northern part of New Zealand, at any rate, are strictly local. At Mount Camel, he states that it is found in a peculiarly dwarf and stunted condition—the same condition is found still further north, and, contrary to the theory which he appears to support, in many localities to the *south* also. But on the other hand, there are luxuriant specimens, twenty feet high, to be seen at Spirits' Bay in the extreme north, which is equally opposed to the theory. At Whangarei, and at Omaha, the tree attains a height of thirty feet, while one hundred miles south of Whangarei it is seen in abundance, only a few inches in height, growing in great luxuriance, and producing well-developed large sized fruit.

In New Zealand this plant attains its extreme southern limit, and ought therefore, if the theory be worth anything whatever, to present generally a considerable amount of variation from its usual forms in Australia, America, and India; but the very opposite is the case, the variations in the New Zealand plant are simply in size and luxuriance, caused evidently by the nature of its habitat as to soil and shelter. In shape of foliage and fruit it is remarkably uniform, never producing the pinnate leaves and partially-developed fruit which, even in Australia, are not uncommon. Exposed to the full force of the wind on a sandy soil, the plant becomes stunted, the branches numerous, short and weak, the leaves small and short-lived; old specimens are frequently laden with twiggy branches, few of which are capable of developing even a solitary leaf. In sheltered woods on a good soil, it reaches its highest degree of development, attaining the height of twenty to thirty feet, with luxuriant foliage. Again, when growing on basaltic rocks the plant becomes extremely dwarf, often less than a foot in height, but not stunted, with the foliage and fruit as luxuriant as in the large sylvestral form. The causes of these departures from the luxuriant type are not far to seek. In the first form the growth of the plant is prevented by poor soil and the action of the wind, at the same time the bark and leaves are prevented from exercising their functions by the sand with which, from their viscidity, they are more or less covered. On the rocky soil the plant is dwarf from lack of nutritive matter for the roots, but is still luxuriant from a two-fold cause—the comminuted state of the limited amount of soil allowing the ready extraction of the nutritive matters it contains, and the unimpeded action of the leaves.

It must however be obvious, that the term *variation* has a very restricted meaning when applied to mere differences of stature and luxuriance of growth, as in the preceding observations, where the instances discussed belong to simple depauperation, and have no necessary connection with the wide subject of morphological variation.

In the present state of our knowledge of the subject, a classified statement of the plants which exhibit aberration from their typical forms, with their

horizontal and vertical distribution, the extent of variation as well as the external circumstances which favour its production, would be a contribution of the highest value to morphological science.* In fact, it is indispensable to real progress. Deductions drawn from isolated examples can seldom be made available for general laws. We have, for example, no evidence to show that the early trifoliate-leaved state of *Melicope simplex* is any proof that the plant has "passed through" other forms whether extinct or recent, than we have that it should be considered indicative of future development. This, however, must not be construed into a positive opinion on the theory involved.

To revert for a moment to the subject of plant variation in the Northern district: it is worthy of remark that all the species of *Veronica* belong, with a solitary exception, to the section with dorsally compressed capsules, but it could not possibly be said that in this district "they appear to present a graduated scale of forms." On the contrary, the amount of variation is extremely limited, and the intermediate forms must be sought for in the southern parts of the colony.

But, on the other hand, the northern genus *Alseuosmia* presents in its four or five recognized forms, an amount of variation in habit and foliation fully equal to that of any similar number of the southern *Veronicas*; and, so far as appears at present, this variation is not affected by habitat.

I have the pleasing duty of tendering my thanks to Mr. Buchanan, for a large amount of information kindly afforded by him; without his valued aid the appended lists of corrections and additions would have been much less complete; also to Mr. Robert Mair and Mr. T. F. Cheeseman, for copious lists of the plants observed by them at Whangarei; and especially to Mr. Colenso, for much valued criticism and information afforded by him during a lengthened correspondence.

In the following notes I hold myself personally responsible for authenticity in all cases not otherwise specified.

NOTE.—Particulars of the Naturalized Plants of the Northern District will be found in the *Transactions of the New Zealand Institute*, Vol. ii., p. 131. The North Cape District and the southern portion of the Whangarei district of that paper, form the area now treated of.

* A knowledge of the aberrant forms of the outlying islands, the Kermadec and Auckland groups, etc., would possess special value.

CORRECTIONS, ADDITIONAL LOCALITIES,* &c., TO PREVIOUS LIST.

(See Vol. ii., p. 242.)

Hymenanthera latifolia, *Endl.*, var Tasmanica. This is *H. crassifolia* of the list, as I find from specimens collected by Mr. Buchanan; it is found also on the Taranga Islands.

Pittosporum Colensoi, *Hook. f.* The northern plant referred to this species by Mr. Buchanan is my *P. virgatum*, easily distinguished from *P. Colensoi* by its terminal capsules. Mr. Colenso informs me that he never saw *P. Colensoi* north of the Waitemata.

Elatine Americana, *Arnott.* Add District 8, on the authority of the "Handbook."

Hibiscus diversifolius, *Jacq.* 2. *Colenso.* 6. The *H. Taylorii* of Buchanan.

Geranium dissectum, *L.*, var. Carolinianum. All the varieties occur, together with the ordinary English form of *G. dissectum*, the latter introduced.

Drosera pygmæa, *DC.* Districts 2 and 8 must be erased, and 6 substituted on Mr. Buchanan's authority.

Callitriche Muellerii, *Sond.* 1 2 3 6.

Panax simplex, *Forst.* This is in part, if not entirely, my *P. discolor*, which was only observed by me at Wangaroa; I have not seen *P. simplex* in the North.

Ozothamnus glomeratus, *Hook. f.* Add 2. "Handbook."

Gaultheria rupestris, *Br.* A clerical error, *G. antipoda* being the plant intended. *J. Buchanan.* Must therefore be erased.

Epacris purpurascens, *Br.* Must be erased. Certainly not found in the North. (See *Trans. N. Z. Institute*, Vol. ii., p. 108.)

Gratiola sexdentata, *A. Cunn.* Add 1.

Glossostigma elatinoides, *Benth.* Add 1.

Veronica ligustrifolia, *A. Cunn.* Add 1. *T. F. Cheeseman.*

" diosmæfolia, *R. Cunn.* Add 1.

Plantago Raoulii, *Dec.* Add 1 2.

Ascarina lucida, *Hook. f.* All the districts except 5 and 8 must be erased. *J. Buchanan.*

Dacrydium Colensoi, *Hook.* Add 8. *R. Bell.*

Prasophyllum pumilum, *Hook. f.* Add 1.

Typha latifolia, *L.* The European *T. angustifolia* has not been found in New Zealand. It is therefore advisable to abandon the name and refer both forms of our plant to *T. latifolia.*

* The districts as divided and numbered by Mr. Buchanan are—1. Whangarei. 2. Bay of Islands. 3. Whangaroa. 4. Stephenson's Island. 5. Mount Camel. 6. North Cape. 7. Kaitaia. 8. Hokianga.

Astelia "grandis," *Hook. f.* Add 1 2.
Eleocharis acuta, *Br.* var. platylepis. Add 1 3.
" gracillima, *Hook. f.* 1 2 3 6.
Isolepis riparia, *Br.* Add 1 3.
" nodosa, *Br.* Add 1 2 3 6.
Cladium glomeratum, *Br.* Add 3.
" teretifolium, *Br.* Add 3.
" junceum, *Br.* Add 1 2 3.
" Sinclairii, *Hook. f.* Add 1 2.
Gahnia ebenocarpa, *Hook. f.* 1 2 3. Erase G. xanthocarpa.
" setifolia, *Hook. f.* Add 2 3.
" lacera, *Steud.* Add 2 3.
" arenaria, *Hook. f.* Add 3.
Carex pumila, *Thunb.* Add 1.
" breviculmis, *Br.* Add 2.
Echinopogon ovatus, *Pal.* Add 1.
Dichelachne stipoides, *Hook. f.* Add 1 2.
Agrostis æmula, *Br.* Add 1 2 3.
" Billardieri, *Br.* Add 1 2 3.
" quadriseta, *Br.* Add 1.
Danthonia Cunninghamii, *Hook. f.* Add 1. *T. F. Cheeseman.*
Poa foliosa, *Hook. f.* I believe this to be an error; I have no recollection of having seen this plant in the North, and can find no mention of it in my notes. It could, moreover, scarcely be expected to occur so far north, unless at a far higher elevation than is found in the district.
Cyathea Cunninghamii, *Hook. f.* Add 1.
Dicksonia squarrosa, *Swartz.* Add 1 3.
Lindsæa trichomanoides, *Dryand.* Erase 2 and 8, which belong to *L. Lessoni.* *J. Buchanan.*
Adiantum formosum, *Br.* Not found in Whangarei proper, but occurs on the west coast. *R. Mair.* The locality is in the Kaipara District, but not on the Kaipara River as stated in the "Handbook."
Asplenium obtusatum, *Forst.* Add 1.
Polypodium rugulosum, *Lab.* Add 1.

ADDITIONAL SPECIES.

Clematis fœtida, *Raoul.* 1.
Ranunculus hirtus, *Banks and Sol.* 1 2 3 6.
" rivularis, *Banks and Sol.*, var. subfluitans. 1 2.
" acaulis, *Banks and Sol.* 1 2.
Drimys axillaris, *Forst.* 1.
Cardamine stylosa, *DC.* 1 2.

Hymenanthera crassifolia, *Hook. f.* "Maritime rocks opposite the Cavallos Islands."—"Handbook."

Pittosporum Buchanani, *Hook. f.* 7. *J. Buchanan.*

„ virgatum, *Kirk.* n. s. 3.

„ ellipticum, *Kirk.* n. s. 1.

„ ovatum, *Kirk.* n. s. 1 3.

„ pimeleoides, *R. Cunn.* 2. "Handbook."

Stellaria parviflora, *Banks and Sol.* 1 2.

Spergularia rubra, *Pers.*, var. marina. Stephenson's Island. *J. Buchanan.*

Hypericum japonicum, *Thunb.* 1 2.

Linum marginale, *A. Cunn.* 1 2 6.

Geranium molle, *L.* 1 2 3 6.

Clianthus puniceus, *Banks and Sol.* 2. *Rev. R. Taylor.*

Coriaria, sps. In a foot-note to Dr. Lindsay's remarks on this genus, in his *Contributions to the Botany of New Zealand*, he writes,—"I find the opinion that there are three 'kinds' of 'Toot' unanimous among the more observant settlers alike of Otago and Auckland, (representing *Wanganui*, Raglan, Coromandel, Kaipara, Hokianga, and other districts in the latter province.)" It is difficult to account for the origin of this error. *C. ruscifolia* is common over the entire province, and varies from a dwarf shrubby or even sub-herbaceous plant, to a small tree; the last form however being comparatively rare. It is possible that the extreme forms may be considered distinct by settlers not well acquainted with the plant, but I never met with anyone who expressed this opinion. Neither *C. thymifolia* nor *C. angustissima* has been found so far north as Auckland.

Ixerba brexioides, *A. Cunn.* 1 2.

Leptospermum ericoides, *A. Rich.* The peculiar dwarf pubescent form mentioned at p. 728 of the "Handbook," is abundant in the open country about Mongonui and in other localities.

Metrosideros lucida, *Menz.* 1. *T. F. Cheeseman.*

„ diffusa, *Sm.* 1 2.

„ Colensoi, *Hook. f.* In the "Handbook" this is said to occur at the Bay of Islands, but Mr. Colenso believes this to be erroneous.

Myrtus obcordata, *Hook. f.* 1. *T. F. Cheeseman.*

Fuchsia procumbens, *R. Cunn.* Cavalhi Passage.

„ Kirkii, *Hook. f.* 2.

Epilobium alsinoides, *A. Cunn.* 1.

„ rotundifolium, *Forst.* 1 2.

„ pubens, *A. Rich.* 1 2 3.

Sicyos angulatus, *L.* 1.

Hydrocotyle Novæ Zelandiæ, *DC.* 1.

„ moschata, *Forst.* 1 2.

Hydrocotyle microphylla, *A. Cunn.* Mongonui.
Apium leptophyllum, *F. Muell.* 2.
Panax Lessonii, *DC.*, var. heterophyllum. 3.
Meryta Sinclairii, *Hook. f.* Taranga Islands.
Viscum salicornioides, *Hook. f.* 1 2.
Alseuosmia quercifolia, *A. Cunn.* 1 2.
Coprosma, n. s. 1.
  „ propinqua, *A. Cunn.* 1 2.
Nertera Cunninghamii, *Hook. f.* 1 2.
Galium umbrosum, *Forst.* 1 2 3.
Olearia lacunosa, *Hook. f.* 2. *J. Buchanan.*
Celmisia longifolia, *Cass.* 2. *W. Colenso.*
Vittadinia australis, *A. Rich.* 1.
Lagenophora petiolata, *Hook. f.* 1 2.
Cotula minor, *Hook. f.* 1 2.
Erechtites arguta, *DC.* 1 2 3.
  „ scaberula, *Hook. f.* 1 2.
  „ quadridentata, *DC.* 1.
Senecio Colensoi, *Hook. f.* 2. *W. Colenso.*
Pratia angulata, *Hook. f.* 1 2.
Dracophyllum Traversii, *Hook. f.* 1. *J. Buchanan.*
Olea apetala, *Vahl.* Taranga Islands.
Limosella aquatica, *L.*, var. tenuifolia. 1.
Veronica macrocarpa, *Vahl.* 2. "Handbook."
Chenopodium triandrum, *Forst.* 1 2.
Suæda maritima, *Dum.* 1 2.
Atriplex Billardieri, *Hook. f.* Whangaruru. *W. Colenso.* North Cape. *J. Buchanan.*
Pimelia Urvilleana, *A. Rich.* 2. "Handbook."
Fagus fusca, *Hook. f.* 1 7 8. *J. Buchanan.*
Urtica incisa, *Poir.* 1.
Parietaria debilis, *Forst.* 1 2.
Australina pusilla, *Gaud.* 1 2. *W. Colenso.*
Phyllocladus glauca, *Carr.* 1. *T. K.* 8. *R. Mair.*
Sarcochilus adversus, *Hook. f.* 1.
Gastrodia Cunninghamii, *Hook. f.* 2.
Acianthus Sinclairii, *Hook. f.* 1 2.
Cyrtostylis oblonga, *Hook. f.* 2. *W. Colenso.*
Corysanthes oblonga, *Hook. f.* 2.
  „ rivularis, *Hook. f.* 2. *W. Colenso.*
Caladenia minor, *Hook. f.* 1 2.
Pterostylis trullifolia, *Hook. f.* 1 2.

Thelymitra longifolia, *Forst.* 1 2 3 6.
" Colensoi, *Hook. f.* 2. *W. Colenso.*
" imberbis, *Hook. f.* 2. *W. Colenso.*
Orthoceras Solandri, *Lindl.* 1 2 3.
Lemna minor, *L.* 1.
Potamogeton "natans," *L.* 1 2.
" "gramineus," *L.* 2. "Handbook."
Astelia, n. s. 1 2 3.
Calorophus elongatus, *Lab.* 1.
Schœnus tenuis, *Kirk.* n. s. 1 2 6.
Gahnia pauciflora, *Kirk.* n. s. 1 2.
Fimbristylis dichotoma, *Vahl.* 2. *W. Colenso.*
Carex subdola, *Boott.* 2. "Handbook."
" lucida, *Boott.* 1 2.
" Forsteri, *Wahl.* 1 2.
Microlæna polynoda, *Hook. f.* 1 2.
Hierochloe redolens, *Br.* 1 2.
Zoysia pungens, *Willd.* 1 2 3 6.
Dichelachne crinita, *Hook. f.* 1 2 3.
" sciurea, *Hook. f.* 1 2.
Danthonia "Unarede," *Raoul.* A stout handsome grass occurring on sea cliffs in Whangaruru Harbour, at the Bay of Islands, and in the Cavalhi Passage, but of which I possess very imperfect specimens only; is provisionally referred here. Its habit is similar to that of *Gahnia setifolia.*
Trisetum antarcticum, *Trin.* 1 2.
Bromus arenarius, *Lab.* 1 2.
Triticum scabrum, *Br.* 1.
Gleichenia Cunninghamii, *Hew.* 1 2.
Cyathea Cunninghamii, *Hook. f.* 1.
" Smithii, *Hook. f.* 1. *R. Mair.*
Hymenophyllum multifidum, *Swartz.* 1 2.
" flabellatum, *Lab.* 1 2.
" æruginosum, *Carm.* 1. *R. Mair.*
Trichomanes venosum, *Br.* 1.
Davallia Novæ Zelandiæ, *Col.* 1 2.
Lindsæa trichomanoides, *Dry.* 1.
Adiantum affine, *Willd.* 1 2.
Lomaria nigra, *Col.* 1. *W. Mair.*
Doodia connexa, *Kunze.* 1. *R. Mair.*
Asplenium flabellifolium, *Cav.* 1.
Aspidium coriaceum, *Swartz.* 1 2.
Nephrodium thelypteris, *Presl.*, var. squamulosum. 1 2. *W. Colenso.*

Nephrodium molle, *Desv.* 1. *R. Mair.*
Nothochlæna distans, *Br.* 1.
Schizæa fistulosa, *Lab.* 1 2.
Botrychium cicutarium, *Swartz*, var. dissectum. 1 6.
Phylloglossum Drummondii, *Kunze.* 2.
Lycopodium Carolinianum, *L.* 7. *W. Colenso.*

Art. XXX.—*Descriptions of New Plants.* By T. Kirk.

[*Read before the Auckland Institute, November* 7, 1870.]

Ranunculus Limosella, F. Mueller. MS.

A stoloniferous aquatic herb, stems submerged, slender, glabrous, leaves solitary or in pairs, much shorter than the petioles, ½″–3″ long, quite entire, linear-oblong or spatulate; flowers minute, one-eighth of an inch in diameter, solitary or rarely two together, peduncles very slender, shorter than the leaves, sepals 4, ovate apiculate, with membranous margins, petals 4, linear purple, acute, recurved at the tips, thrice as long as the sepals; stamens 8–12, filaments twice as long as the ovate anthers, pistils usually 8, gradually tapering into the almost straight capillary style, ripe carpels somewhat swollen at the base, lax, style recurved, one-fourth of a line long.

Forming matted patches on the shores of lakes and in water not more than ten feet deep, but only flowering on the shores, where the entire plant is minute and easily overlooked, or may be readily mistaken for *Limosella aquatica.* In habit resembling *R. pachyrrhizus*, Hook. f., but is more closely allied to *R. rivularis*, Banks and Sol., and is at once distinguished from all New Zealand species of the genus by the quaternary arrangement of the floral organs.

In the Whangape, Waikare, and Waihi Lakes, Waikato, *T. K.*

I am indebted to my friend, Dr. F. v. Mueller, for valuable notes on this curious little plant, for which I have adopted the name proposed by him.

Acæna Novæ Zelandiæ, Kirk. n. s.

A prostrate herb, with branches occasionally woody at the base, tips ascending, leafy, glabrous or with scattered silky hairs; leaves 2″–3″ long, pinnate, leaflets sessile or in short pedicels, elliptic, rounded at both ends, deeply sharply toothed, the teeth tipped with silky hairs; scape leafless, glabrous; heads ¾″ in diameter; flowers green, calyx tube very silky, the

angles produced into 4 reddish purple spreading bristles tipped with numerous white barbs, petals 4, ovate-acuminate, green, stamens 2, filaments elongating, anthers lobed ; stigma plumose.

This plant is easily recognized by the pale-green hue of its leaves. Compared with *A. Sanguisorbæ*, Vahl., its capitulum is larger and less compact, owing to the larger size of the flowers and spreading bristles. The plumose stigma distinguishes it from *A. adscendens*, Vahl.

Its globose heads are occasionally uni-sexual, and, as is the case with *A. Sanguisorbæ*, Vahl., a few detached flowers or small clusters are sometimes produced below the head. It seems possible that the Hybrid *Acæna* mentioned at page 25 of *Proceedings of the New Zealand Institute*, 1870, may be referred to this state of the common species.

Common on the Auckland Isthmus and in other parts of the province.

Dr. Hooker informs me that until recently no specimens of this plant had been received at the Kew Herbarium, although it has been cultivated in English gardens for two or three years past, under the name by which I have now designated it.

In the *Flora Australiensis*, *A. ovina*, A. Cunn., is erroneously stated to extend to New Zealand. I believe it occurs in a naturalized condition near Wellington.

Fuchsia Kirkii, Hook. f. MS. n. s.

Stem woody, with prostrate or sub-erect slender wiry branches, leaves alternate, orbicular ovate, or cordate, $\frac{1}{4}''$–$\frac{1}{2}''$ in width, shorter than the slender petioles, obscurely toothed, membranous. Flowers axillary, solitary, $\frac{3}{4}''$ long, on short drooping peduncles ; calyx tube bright orange, sepals linear-ovate, obtuse, greenish, petals 0, stamens exserted, anthers oblong, ovary ovate, stigma 4-lobed, berry oblong, deep purple.

This plant appears to affect the neighbourhood of the sea, and has only been collected on the Great Barrier and in Whangaruru Harbour.

It will prove an acquisition to the cultivator.

Panax discolor, Kirk. n. s.

A much-branched shrub, 6–20 feet high, diœcious, bark of young branches and leaves, especially on the under surface, having a peculiarly bronzed appearance. Leaves on rather slender petioles, 1″–2″ long, 3-foliolate, leaflets 2″–3″ long, obovate-lanceolate, cuneate at the base, coarsely and sharply toothed, never sinuate-pinnatifid, glossy, rarely a few unifoliolate leaves are found mixed with those of the ordinary form. Panicles invariably terminal, male flower of a few rays 2″–3″ long, flowers on slender pedicels $\frac{1}{4}''$–$\frac{3}{8}''$ long, female flower much shorter, rays and pedicels stouter, fruit nearly as large as

in *P. Lessonii*, styles 5, tips recurved, flowers greenish yellow. Wood white, hard, tough; resembling *P. simplex* in general appearance, but the leaves are alike in all stages, the panicles diœcious and terminal, and styles 5. More closely allied to *P. Sinclairii.*

From the sea-level to 2300 feet. Cape Colville Ranges, Great and Little Barrier Islands, Great Omaha, Whangaroa (North), *T. K.*

Olearia Allomii, Kirk. n. s.

A low shrub, varying from a few inches to two feet in height, branching from the base, branches few, stout. Leaves oblong, unequal at the base, excessively thick and coriaceous, obtuse, shining, reticulate above, principal veins diverging from the mid-rib nearly at right angles, mid-rib prominent below, often giving the leaf a keeled appearance, leaf covered below with densely appressed, silvery, shining, tomentum, 1″–2″ long, rather closely set; petioles short, stout; corymbs longer than the leaves, peduncled, downy, spreading, lax, many-headed, simple or slightly branched. Heads on stout downy pedicels ¼″–¾″ long, large, broad; involucre cylindrical; scales numerous, imbricate, broadly lanceolate, obtuse, puberulous or downy; florets 6–8; rays about 8, broad, notched at the apex, white; pappus brown spreading, feathered. Achenes downy.

In rather open places on the Great Barrier Island; frequent from 800 to 2300 feet.

Allied to *O. Haastii*, Hook. f., from which it differs in its extremely dwarf, rigid habit, in the larger size of all its parts, excessively coriaceous leaves, and loosely imbricated involucral scales.

This plant was discovered on Mount Young by A. J. Allom, Esq., Captain F. W. Hutton, and myself, in November, 1867. I have done myself the pleasure of naming it after Mr. Allom, as a pleasant memorial of his valued aid when exploring the Great Barrier Island.

An *Olearia*, with leaves resembling those of the present plant, but attaining the height of 12′–15′, and closely branched, occurs at the Whenuakite River, Mercury Bay. I have not been able to identify it in the absence of flowers and fruit.

Mimulus Colensoi, Kirk. n. s.

A small erect herb, 3 to 6 inches high, glabrous in all its parts. Leaves oblong, sessile, scrobiculate, succulent, entire. Flowers solitary, on short axillary peduncles. Calyx tubular, contracted just below the mouth, irregularly 5-toothed, corolla very large, pure white with yellow throat, lower lip much produced, entire, capsule ovate-acuminate.

Allied to *M. repens*, from which it differs in its unbranched erect habit and scrobiculate leaves.

In marshes, Onehunga.

I have great pleasure in naming this pretty plant after Mr. Colenso, who appears to have been its original discoverer.

Corysanthes Cheesemanii, Hook. f. n. s.

Root of small tubers on rather stout caudicles. Leaf membranous, sessile, $\frac{1}{2}''$ in diameter, ovate-cordate, apiculate. Bract very short, rarely petaloid and coloured. Flower $\frac{5}{8}''$ long, rarely more, sessile or shortly peduncled. Upper sepal very large, helmet-shaped, curved over the lip, obovate, obtuse, rarely acute. Lip involute, large, the margins enclosing the column, two-lobed at the base, the lobes produced downwards into two horn-like processes, apex of the lip recurved. Lateral sepals 0, or rarely concealed under the lip, and spirally twisted. Petals minute or wanting, subulate, deflexed. Column stout, erect. Anther terminal, persistent. Peduncle elongating after flowering, capsule narrowed upwards, striate.

Te Whau, 1865, *T. K.* Ourakei, *Mr. T. F. Cheeseman*, 1867. Titirangi, *T. K.*

I obtained a few imperfect specimens of this interesting plant from the Whau District about five years ago, but not in a fit state to allow of a diagnosis being drawn. Mr. Cheeseman subsequently found it in some quantity, and has kindly favoured me with good specimens and valuable notes, of which I have availed myself in drawing the foregoing description.

It is the earliest-flowering species in this colony, usually displaying its dull purple flowers early in July. It will probably be found to have a wide range of distribution.

All the species of *Corysanthes* previously discovered in New Zealand belong to the sub-genus *Nematoceras*, Hook. f. The present species belongs to the typical section of the genus.

Art. XXXI.—*On the Cultivation of some Species of Native Trees and Shrubs.*

By T. H. Potts and W. Gray.

[*Read before the Wellington Philosophical Society, September* 17, 1870.]

Many of the writers and travellers who have described the physical appearance and natural scenery of New Zealand, have dwelt with more or less enthusiasm on the remarkable character of the beauty of our native forests, on the noble trees, amongst which the *Coniferæ* occupy so distinguished a position, and the ever-varying foliage of the luxuriant shrubs, of which so many species are peculiar to these Islands. Although a century has elapsed since that epoch, at which a far from insignificant portion of the flora of this country became known to botanists, and notwithstanding that the footsteps of Banks and Solander have been followed at intervals by many men of science, it may be considered a matter of surprise that so little has been made known of the habits of many genera, and that so few persons have devoted much time and attention to their cultivation. That this neglect of our most interesting indigenous plants is a matter of regret, few of those will be disposed to question who have had opportunities of becoming personally acquainted with the present condition of many districts, and who cannot fail to have reflected on the destructive results to our native flora which the rapid settlement of the country is daily effecting. The constantly recurring bush fires, the means by which the tenant of crown lands seeks to improve the condition and quality of the grasses for the depasturing of his stock, and the wasteful management of the once magnificently timbered forests, threaten at no distant period the almost entire destruction of many interesting and valuable species, before time has been afforded to ascertain their real position as a portion of the economical resources of the country. In the Middle Island, the localisation of the bushes and shrub-covered areas, may have exercised a deterring influence, not without its effects on the newly formed shrubberies and plantations of the settler.

The object of this paper is simply to draw attention to the cultivation of native plants, and to impart, very briefly, such information as may have been acquired from the experience of several years, during which many species have been cultivated. One of the chief reasons which has induced the communication of these observations, is the knowledge of the fact that many persons show almost a prejudice against planting native shrubs, from the supposed difficulty attending their successful treatment.

That the efforts of some beginners have been marked by failure, is not altogether a matter for surprise; often with the hope of making a show at once, specimens are selected from the bush which are too large, and too old, to be safely removed; in too many cases the planter contents himself with tearing up the young and tender seedlings from the moist shelter of the bushy

gullies, transplanting the flagging shrubs, with roots bruised and ruptured, to the open borders of the garden or shrubbery, where, in all probability, they are equally exposed to the icy blast of the south-west gales and the desiccating influence of the parching north-wester. Let the intending grower place some portion of a decaying log, rich in its panoply of various-hued lichens, beside the newly removed plants, and a convincing proof will be afforded of the *sudden* change of atmospherical conditions they are expected to encounter and survive, as he gazes on the shrivelled objects to which a few days exposure has metamorphosed the luxuriant lichens. An equal want of consideration for the habits of plants may be noted where alpines (to which a free circulation of air is a necessary condition of healthy growth, if not of life), have been buried beneath the shade and drip of overhanging trees. To these hints as to the desirableness of shelter in the tender stage of their earlier growth, should perhaps be added, that planting in too close proximity to fast growing but exhaustive *Eucalypti* should also be avoided.

Amongst the groups of plants on the cultivation of which it is proposed to offer remarks, many will be found of the most ornamental description, beautiful in foliage, compact in form; some, from their habit of growth, adapted for training as impervious screens; from the many flowered corymbs of others, fragrant odours are diffused; whilst the native hardiness of several species, points them out as worthy of cultivation from their being calculated to afford grateful shelter in the bleakest situations. All are desirable acquisitions to the garden, the shrubbery, or the plantation, and have a right to and are worthy of a home in public Botanic Gardens of the colony.

In view of the progress which is being made in the formation of plantations, by the efforts of many enterprising settlers in several districts in both islands, the value of many species of native shrubs, as nurse plants for sheltering exotic forest trees, must be recognized, as their aid during the earlier and tender stage in the life of many a valuable timber tree, will be found materially to assist its successful acclimatization. *Coprosmas* and *Olearias* at once occur as groups admirably adapted for this purpose, from their hardiness of constitution, closeness of foliage, and the ease with which they can be removed with safety.

It is to be hoped that the formation and proper organization of Botanic Gardens will not be much longer deferred; each year's delay is a national loss, whether it is considered from a scientific, educational, or commercial point of view; by the establishment of such gardens, it is not meant that such institutions should be considered as carried out successfully when certain reserves of land are set aside, and marked off on a map. In order to confer the greatest amount of public benefit, such establishments should be carefully but vigorously administered. Appreciative foreigners are ever anxious to obtain collections of our native flora, and interesting exchanges would soon occupy an important

position, the value of which would be at once recognized. Much additional usefulness would be derived from the support of a laboratory in connection with the most prominent of such gardens, in order that the aid of chemistry might be invoked, to demonstrate what of value we might be enabled to derive from the remains of our vegetable wealth. It might also teach us to look with regret on the charred and blackened stumps of what were once noble forests, on the wide areas of country lately covered with heavy luxuriant bushes of *Phormium*, as bearing evidence against us of a wasteful and costly system of settlement, that would then be no longer tolerated.

We have adhered to the nomenclature and arrangement as given in that valuable boon to the colony, Hooker's *Handbook of the New Zealand Flora*, which must be appreciated by every one who takes an interest in the vegetable kingdom.

The time of flowering given, is the period when the species blossom in Governor's Bay, near Lyttelton,—a locality which enjoys the advantage of a certain amount of shelter from south-west weather, but is open to the sea breeze from the north-east, the prevailing wind.

DICOTYLEDONS.

Ranunculaceæ.

Clematis indivisa, Willd. May be found in abundance in most of the bushes throughout the country; in early spring (September and October), its long wreaths of star-like white flowers may be observed hanging in graceful festoons from the tops of the highest trees. In any ordinary soil that is not too dry it flourishes well, it is easily raised from seed, it can be propagated by cuttings, bears transplanting with ordinary care. A specimen growing here was covered with a fine show of blossom in the fifth year from the seed. Seed should be collected as soon as ripe, as the downy achenes are soon dispersed by the wind.

Clematis, sp., Colensoi. Usually found on the outskirts of some bushy gully, but is not so common as the preceding species. Through the months of October and November its dull yellowish blossoms diffuse an agreeable scent.

Magnoliaceæ.

Drimys axillaris, Forst. The well known Pepper-tree has a very extensive range; it is frequently observed outside of the bush, but the foliage of this handsome aromatic shrub appears to the greatest advantage in shady nooks. It maintains an excellent form, the bright green upper surface of the leaf, dotted with red spots, contrasting with the whitish underside, gives the plant a very cheerful look, and makes it a desirable addition to the shrubbery. It is of slow growth; although very hardy, it is well to remember, the better the shelter the greener the leaf. It flowers as early as August; its small yellow star-like blossoms give out a faint fishy odour.

VIOLARIEÆ.

Melicytus ramiflorus, Forst. In many parts of Banks' Peninsula, this tree is known as "Cowleaf," from the avidity with which its leaves are devoured by cattle. Tolerably hardy, this close-growing shrub, with its dark green lanceolate leaves, is admirably adapted for screen hedges; it will bear cutting-in to any extent. It thrives in any ordinary soil, is easily raised from seed. Its bluish black fruit, with which its sprays are clustered, form a favourite food for birds. In June, 1868, we found on the Peninsula, a variety of this species with *white* seeds. Flowering season is in November.

Melicytus lanceolatus, Hook. f. A handsome pale green shrub with very long lanceolate leaves, its purplish flowers are very small. This plant will not thrive well in a very bleak exposure, but with a little attention to shelter its growth will be found very rapid. Flowers as early as August.

PITTOSPOREÆ.

Pittosporum Colensoi. An ornamental tree, as a single specimen plant or with plenty of room it maintains a beautiful conical form of growth; it bears close pruning well, and is adapted for screens. Its dark purple flowers are in blossom from November to January. This species is frequently mistaken for *P. tenuifolium*.

Pittosporum tenuifolium. Has a very compact form of growth; it bears a strong resemblance to the preceding species, but the leaves are smaller and paler green.

Pittosporum obcordatum, Raoul. Not very common; we have met with specimens having stems about 8 inches in diameter. It is of straggling growth, the branches much interlaced, and is better adapted for mixing with other shrubs rather than for planting in a front row or open space.

Pittosporum fasciculatum, Hook. Our specimens were procured from the Otira Gorge. This handsome close-growing species is of robust habit, and a fast grower.

Pittosporum crassifolium, Banks and Sol. This large shrub contrasts well with other *Pittosporeæ*; its obovate leaf frequently measures 3½ inches in length, the sides slightly recurved; both leaf and stem exhibit resinous exudations.

Pittosporum eugenioides, Cunn. This beautiful shrub always excites admiration, from its shapeliness and the delicate green of its long finely-veined undulated leaf, to which the almost white midrib lends its share of beauty. Not only do the corymbs of pale yellowish blossoms yield a delicate fragrance, but the leaves, when bruised, emit a strong lemonish scent. With space, the Tarata maintains a shape which renders it one of the chief ornaments of the shrubbery. The seeds are less abundantly covered with gluten than some of the species, and require two years to ripen. Blooms in October.

Pittosporum cornifolium, Cunn. Small plants of this species are growing well that were raised from seed obtained from boughs cut when the seed was in a half-ripened state, the boughs having been kept fresh by insertion in the ground.

The *Pittosporeæ* flourish in any ordinary soil; they are easily raised from seed; should be moved with care; the seedlings should be shifted once or twice in the nursery before they are finally planted, if this practice is adopted the cultivator will surely find that he has *not* lost either time or trouble by so doing.

MALVACEÆ.

Plagianthus divaricatus, Forst. A singular looking shrub, growing close to the sea shore in Port Cooper; its slender sprays are so much interlaced as to form a stiff compact mass, capable of sustaining a considerable weight. It flowers in the month of December.

Plagianthus betulinus, Cunn. One of our few deciduous trees; in its young state it has a graceful form of growth. Flowers in December.

Plagianthus Lyallii, Hook. f. This tree or shrub is one of our handsomest flowering plants; it is found at very considerable altitudes in "the back country," and is useful where *Phormium* is rarely, if at all, to be met with; a strip of the lace-like bark of the Ribbon-scrub answers all the purposes of a flax leaf to the bushman. Its handsome white flowers may be seen in December and January.

Ordinary soil, not too stiff, appears most suitable to this family; they transplant freely, and may be propagated by cuttings.

TILIACEÆ.

Entelea arborescens, Br. The Whau, or native Mulberry, is remarkable for its immense cordate leaves; it is impatient of cold exposure. We have not yet succeeded in acclimatizing it here; it appears to thrive well in warm moist situations without requiring any particular attention to be paid to it. Should sericiculture obtain a footing in the colony, it would be worth while to ascertain, from actual experiment, whether the leaves of the *Entelea* would be suitable food for the silkworm.

Aristotelia racemosa, Hook. f. A handsome thinly-foliaged tree, the light green serrated leaves contrast agreeably with the dark reddish bark of its sprays. It is an early bloomer, its panicles of reddish flowers varying in tint from deep claret to the faintest pink, may be sometimes observed as early as August. It bears pruning well, and this it requires to keep it within bounds, as it is apt to become straggling if this is neglected. From its abundance of fibrous roots, it can survive a great deal of rough treatment in transplanting.

Aristotelia fruticosa, Hook. f. Our specimens were procured from near the head waters of the Rangitata. In its natural state it rarely exceeds, even if

it attains, a height of 6 feet; it is exceedingly hardy, and like the preceding species, any ordinary soil suits it, and it is managed without the slightest difficulty; its deep green foliage is seen to the best advantage when it is grown with a southerly aspect.

OLACINEÆ.

Pennantia corymbosa, Forst. Common in the bush on Banks' Peninsula. It is a plant of graceful habit; its white fragrant flowers cover it in the greatest abundance. In its young state the leaves are small and rounded, but a remarkable transformation takes place, and it assumes oblong leaves nearly three inches in length. Blossoms in December. Its cultivation calls for no particular remark.

RHAMNEÆ.

Discaria Toumatou, Raoul. The scrubby-looking plant, known as the "Wild Irishman," becomes quite a tree above the gorges of some of the great southern rivers; its wood, from its hardness and durability, is in great request for stock-whip handles; any soil appears to suit this plant. In November its creamy coloured flowers charge the air with their powerful fragrance. Some of the finest specimens with which we are acquainted surround the grave of the lamented Dr. Sinclair, on the banks of the Rangitata.

SAPINDACEÆ.

Dodonæa viscosa, Forst. This handsome-looking tree is clothed with foliage of a peculiar tint, which at once arrests attention; it appears to flourish best at no great distance from the sea. Its flowers, of reddish hue, are succeeded by seeds enclosed in membranous-winged coverings, reminding one somewhat of the "keys" of some of the British forest trees.

Alectryon excelsum, DC. The Titoki, or New Zealand Ash, is far from uncommon in many districts; in the neighbourhood of Wellington it appears to grow with considerable vigour, but here we have found some difficulty in its cultivation. Its panicles of flowers may be noticed during November and December, but it is when the tree is in fruit that it assumes its most striking appearance, from its abundance of peculiar looking scarlet berries.

ANACARDIACEÆ.

Corynocarpus lævigata, Forst. This fine laurel-leaved shrub is very local in Canterbury, its habitat being almost, if not entirely, confined to Okain Bay, Little Akaroa, and perhaps a few other spots in that district. We have heard it suggested that its presence there is owing to the fruit brought down in old times by the canoes crossing Pegasus Bay from the North Island. Near the sea, in sheltered spots, it grows fairly, but we have lost a considerable percentage from planting out when too small. It luxuriates in a rich damp soil, and grows readily from seed. The drupe appears to be held in great estimation by the Maoris as an article of food.

LEGUMINOSÆ.

Clianthus puniceus, Banks and Sol. One of the most beautiful of all shrubs; is too well known to require any remark.

Sophora tetraptera, Aiton. This valuable tree is very peculiar looking in its young state, when its flexible sprays are so much interlaced, that it appears almost incredible that from the thicket of pliant twigs should be produced the graceful straight-stemmed tree, the wood of which is unsurpassed for fencing purposes. From the end of August, through September and October, its racemes of yellow flowers make a handsome appearance. The young trees are frequently injured by the attacks of a boring insect. From about midsummer, through the early part of January, its leaves supply food for a caterpillar that entirely strips its foliage, leaving the trees bare for two or three weeks. The Kowhai prefers a cool moist situation, and even then it makes very slow growth. On very bleak exposures a decumbent variety is frequently met with.

ROSACEÆ.

Rubus australis, Forst. This straggling fast-growing climber may be usefully employed to conceal some unsightly spot. Its sharp recurved prickles not only extend over leaves and sprays, they even defend its panicles of fragrant blossoms, which perfume the air in the month of November. Some day the distiller of perfumes may turn this shrub to account; we have tried experiments by *enfleurage*. Excellent baskets can be manufactured from the stems.

SAXIFRAGEÆ.

Carpodetus serratus, Forst. A small round-headed tree, with mottled bark; in its young state the leaves are small and rounded, as it grows up they assume an oblong shape, handsomely variegated, the darker shade of green following the course of the nerves. The finest foliaged specimens we ever met with were growing in the bushes near the River Wilberforce. About midsummer, its panicles of white flowers are produced in abundance. Any fair soil suits the *Carpodetus*, which prefers a cool moist aspect.

MYRTACEÆ.

Leptospermum scoparium, Forst. The Manuka is too well known to all settlers to need description. There are few prettier sights than a patch of it in November or December, when the whole scrub is a mass of white blossoms, as though it had just received a light fall of snow.

Leptospermum ericoides, Rich. The Bush Manuka, as it is called, attains a considerable size, the leaves smaller, darker, and narrower than those of the other species, the blossoms also are smaller and later in their season of flowering. Both species under cultivation grow faster than is usually supposed; they are very exhaustive, their fine matted fibrous roots completely

dry up the soil near its surface; when cut down, the trees die at once, not making any attempt to shoot or break.

Metrosideros lucida, Menz. A very handsome myrtle-like foliaged shrub, growing in many places to a large tree; in its native state the Rata is usually found growing amongst the crevices of rocks, which, during the month of January, are enlivened with its brilliant scarlet blossoms. We have had this plant under cultivation for many years; in good soil, it makes fine vigorous growth; it may be raised from seed (which requires a considerable time to ripen); it can be propagated by cuttings; after a shift or two, it forms such a mass of fibrous roots that it can be removed with perfect safety. It is hardy enough for any aspect; a free current of air is absolutely necessary to preserve its compact habit.

Metrosideros tomentosa, Cunn. The Pohutukawa under cultivation grows in a compact form, and blossoms freely; with us, its growth is slower than that of *M. lucida*, but it is hardy enough to withstand the rigour of our winter.

Myrtus bullata, Banks and Sol. A nice-looking upright-growing shrub, which often may be noticed under cultivation in the North. The yellowish green leaf presents a blistered appearance.

Myrtus obcordata, Hook. f. Common about the bays of Port Cooper, where it may be frequently observed on the outskirts of the bush, attaining the size of a small tree, from 6 to 12 inches diameter. It is of slow growth, but compact habit; its small pale green obcordate leaves are variegated with a brownish green tint on the margin and along the course of the nerves. Flowers in December.

Myrtus pedunculata, Hook. f. Far less compact than the preceding species; its glaucous leaves are somewhat oblong. Blossoms in December; grows best in a shady situation.

The Myrtles thrive in any light soil, not too wet, and are easily raised from seed.

PASSIFLOREÆ.

Passiflora tetrandra, Banks and Sol. This lofty climber shows itself best when clothing a round-topped tree of moderate height, adorned with its bright clusters of orange coloured fruit; although it is found on the outskirts of the bush, it requires a sheltered situation, the frost affecting it far more than winds. It is easily removed, and grows freely from seed; thrives best in light soil, not too dry.

ARALIACEÆ.

Panax longissimum, Hook. f. This peculiar looking tree presents a complete contrast to all other natives, from its straight erect rod-like stem with drooping coriaceous leaves, that sometimes measure above 2 feet in length. After some years the stem becomes branched about ten or twelve feet from

the ground, the leaves then are much diminished in size. This plant requires some attention during removal; after recovering from the check, it makes fair growth. A specimen here, planted in fair loam ten years since, now measures 13 feet 6 inches in height; stem rather more than 1 foot 2 inches circumference a few inches above the ground; it commenced forming its branched head two years since; when moved into the shrubbery it was about 2 feet 6 inches in height, and the rod about the thickness of a finger.

Panax Colensoi, Hook. f. A finely foliaged tree, with large deep green glossy leaves; an excellent species for shelter or for the shrubbery. Its large clusters of purple-black fruit are very conspicuous; it can be removed without difficulty. Both this and the preceding species flourish in ordinary soil.

Shefflera digitata, Forst. Handsome foliaged shrub, with large slightly drooping digitate leaves, found chiefly on the banks of shady creeks; its panicles of pale yellowish green blossoms, which may be observed in October and November, convey some idea of a resemblance to a gigantic spike of mignionette. Any soil suits it, with a moist sheltered situation.

CORNEÆ.

Griselinia lucida, Forst. Frequently observed growing on trees, apparently parasitical, but with its roots striking into the soil; it has been noticed with its roots reaching the ground through the hollow stem of a decaying tree. Its large pale green coriaceous leaf is of peculiar shape. Far more tender than *G. littoralis*, it flourishes in fair soil with a sheltered aspect; removed without difficulty.

Griselinia littoralis, Raoul. One of the best and hardiest shrubs for shelter, it will flourish in the coldest places; it bears close pruning. The pale yellowish green leaf of this densely foliaged plant affords a pleasing contrast in the shrubbery. In too sheltered a position it is liable to be much affected by scale. Its yellowish green flowers, which bloom in September, October, and November, are almost scentless; fruit dull black. No tree is transplanted with less risk, even when of a large size. In its natural state, the Kapuka, or Broad-leaf, attains the dimensions of a large forest tree.

Corokia cotoneaster, Cunn. A brown-looking shrub of very dwarf habit, with branches much interlaced; often found on the outskirts of bushes on the hills; upper side of the bright brownish leaves are contrasted with a white tomentose under surface. Its yellow blossoms may be seen in the month of November, the drupe is yellowish; it is of hardy constitution; it grows fairly from seed, is transplanted without difficulty; prefers a south-west aspect, not too much shaded.

LORANTHACEÆ.

Loranthus flavidus, Hook. f. A thinly foliaged parasite that may frequently be observed growing upon *Fagus* trees, on the outside of forests.

Flowers yellow. We have noticed it growing upon small trees of *Fagus Cliffortioides*, in a shrubbery where the soil was both cold and stiff, and that too in a situation much exposed to heavy winds.

Loranthus micranthus, Hook. f. A fast growing parasite found on a variety of plants, introduced as well as native; amongst the former we have observed specimens attached to *Cratægus*, plum, peach, and laburnum, this species thus ranging over, and as we conceive showing a preference for, species belonging to the foreign natural orders *Pomaceæ*, *Drupaceæ*, *Fabaceæ*. Our opinion that this species of *Loranthus* exhibits a preference for introduced trees, is founded on the following observations:—in this neighbourhood it may be found growing in the bushy gullies, and in the bush itself, on trees of *Melicytus ramiflorus* and *Melicope simplex*, representatives of *Violariæ* and *Rutaceæ*; in the shrubberies which impinge upon and partly bound the gardens, plants of the two native species just named do not exhibit one single specimen of *Loranthus*, nor on any native tree is an example of this particular kind of parasite to be found, nearer than about half a mile's distance, in a bushy gully, yet specimens may be noticed in the garden flourishing on representatives of the three foreign natural orders before mentioned. On the laburnum the *Loranthus* appears to grow quite luxuriantly, a plant now four years old, the beautiful green ovate leaves of which form a thick-set bush measuring 4 feet through, vertically, by 3 feet 6 inches through, horizontally; a specimen on a *Cratægus* of the same age, measures 1 foot through, vertically, by about the same measurement horizontally. Both laburnum and thorn were removed two years since, in the course of some alterations, without causing the slightest apparent injury to their parasites. In October the green blossoms of the *Loranthus* are abundantly produced, yielding a very delicate perfume; the yellow drupe is a favourite bird food.

Tupeia antarctica, Cham. and Schl. By the sea shore, in some places about Port Cooper, dense clusters or bushes of this pale green parasite may be observed, perhaps more frequently on trees of *Panax Colensoi* than on any other shrub; however, it is now and then to be met with growing on *Loranthus micranthus*; it is later in its season of flowering than that *Loranthus*; the berry is green, afterwards white, and at last changes to a rosy hue.

Rubiaceæ.

We have ten or twelve species of *Coprosma* under cultivation, of which one of the most hardy and interesting is the new sub-alpine species *C. seratulus*, Hook., which has been added to our flora by Dr. Hector since the publication of the *Handbook.*

Coprosma lucida, Forst. A small tree or shrub, with bright shining very dark leaves, well adapted for a screen; it bears close pruning; tolerably hardy. Flowers in October.

Coprosma Baureiana, Endl. This handsome native, flourishing by the sea shore, is conspicuous from its recurved bright leaves showing their paler under surface. It is moderately hardy.

Coprosma robusta, Raoul. Well known as the Karamu, this common plant is invaluable as shelter for the shrubbery or plantation; it is fast-growing; like the rest of the family its blossom is very unattractive, but when in fruit, with its crowded clusters of yellow-red berries, is a beautiful object. We have found a variety of *C. robusta* bearing equally crowded clusters of drupes, of the same size and shape precisely, but of pearly whiteness.

COMPOSITEÆ.

Olearia Colensoi, Hook. A very handsome shrub, of great natural hardiness; may be found growing in Arthur's Pass abundantly. Its foliage is striking; its oblong very coriaceous leaves of bright green above, with the under surface covered with buffy tomentum, are serrated, bearing a large next a small tooth, in *regular alternation.* Its dense habit of growth must render it a valuable acquisition to the shrubbery.

Olearia nitida, Hook. f. A very stiff-growing shrub or tree; leaves coriaceous, with silvery tomentum on the under surface; the large corymbs of almost white blossoms are very fragrant. It is one of our hardiest species; easily propagated by cuttings.

Olearia dentata, Hook. f. A fine shrub with handsome toothed leaves, which, on being rubbed, yield a musky odour; it is easily propagated by cuttings. We have not seen plants of this species equal in size some specimens of *O. ilicifolia*; the bark is not so dark as in that species. We do not think this species and *O. ilicifolia* so very closely allied.

Olearia Traversii, Muell. This well known species, from the Chatham Islands, grows freely, but takes many years to flower; a specimen that has been in the border ten years, has not yet exhibited any blossom. It strikes from cuttings if they are placed in a shady spot.

Olearia ilicifolia, Hook. f. In some places this stiff-growing shrub reaches the dimensions of a tree; its dull green long narrow leaves, waved at the edges, give out an aromatic scent on being rubbed; its corymbs of whitish blossoms are very fragrant; it bears pruning well. Unlike *O. dentata*, which strikes so freely, this *Olearia* is most difficult to propagate by cuttings.

Olearia Cunninghamii, Hook. f. A fine foliaged plant with long lanceolate leaves, carried much after the same manner as those of a well grown *Drimys.* Our specimens, procured from the neighbourhood of Wellington, are sufficiently hardy to withstand the winter without injury.

Olearia moschata, Hook. f. A small foliaged compact-growing alpine shrub, with under surface of the leaves remarkably tomentose. We cannot perceive the appropriateness of *moschata*, as applied to this species when cultivated, in

which state we have been unable to detect any musky odour either in the flower or leaf. When growing in its native habitat, it however possesses this odour in a marked degree. Very hardy. We have procured specimens from a locality a few miles below the Rangitata glacier. It grows from cuttings most freely.

Olearia nummularifolia, Hook. f. A very erect-growing shrub with small obtuse leaves; exceedingly hardy; it is a most desirable acquisition for the front row of the shrubbery. Grows well from cuttings.

Olearia cymbifolia. Found in abundance on the spurs of Mt. Potts; its habit is very similar to that of the preceding species; its hard coriaceous leaves are so extremely recurved that the margins nearly meet; the flower heads are not solitary, as in *O. nummularifolia*, neither does it strike so readily from cuttings as that species. Another variety, from the River Clyde, has larger leaves than either of these two species, with flowers as in *O. cymbifolia*, but with leaves less recurved; it is propagated by cuttings more readily than that species.

Olearia Forsteri, Hook. f. A very common shrub about Banks' Peninsula; capital shrub for shelter; it lasts in blossom during the midsummer months, giving out a powerful fragrance; the flowers attract multitudes of *Lepidopteræ*. Its leaves are subject to attacks from insects. It can be propagated by cuttings, but young seedlings can always be found in abundance in any bush where the species is found growing.

Olearia avicenniæfolia, Hook. f. A mountain shrub, less densely foliaged than many other species; it is very hardy, and may be usefully planted as shelter in the bleakest spots. Its whitish flowers are fragrant. Freely grows from cuttings, but abundance of young plants can be obtained, as in the case of *O. Forsteri.*

Olearia virgata, Hook. f. A somewhat straggling shrub, with extremely narrow leaves; its creamy white blossom gives out a fragrant scent. We possess at least two varieties of this species.

Olearia Solandri, Hook. f. A very common shrub on the hills about Wellington Harbour; it is of upright growth, rather formal in appearance.

The whole family of *Oleariæ* flourish under ordinary cultivation in almost any soil; they are useful for shelter, as the majority of the species are most hardy; they are easily raised from seed, can be transplanted without trouble, and, with the exception perhaps of *O. ilicifolia*, are readily propagated from cuttings. The blossoms diffuse a powerful odour.

Cassinia retorta, Cunn. A small-leaved dense-growing shrub, with under surface of leaf tomentose; very common about Port Nicholson. From its silvery appearance is valuable for contrast in planting.

Cassinia leptophylla, Br. One of the commonest river-bed shrubs, too frequently met with to be held in much esteem. In habit of growth it closely

resembles *C. retorta*. Its general colour is dull yellowish brown. Flowers in December.

Cassinia fulvida, Hook. f. Is extensively distributed amongst the hills; general colour brownish green. Flowers in December.

Cassinia Vauvilliersii, Hook. f. Handsomest foliaged plant amongst the *Cassinæ*. Our specimens were obtained from the Otira Gorge, but it is generally distributed over the low hills. Colour deep dark green; leaf slightly recurved. Flowers in December and January.

All the *Cassiniæ* are hardy, grow well in light soil, thrive in any aspect, can be propagated by cuttings or transplanted easily. Perhaps, owing to the attacks of insects on the seeds, we never find seedlings, although the various species have been grown and flowered here for several years.

Ozothamnus glomeratus, Hook. f. This singular looking shrub is not unfrequently met with on the hills. It grows into a dense bush, the slender drooping branches with woolly points being very much interlaced. General colour a bronzy green.

Ozothamnus microphyllus, Hook. f. A depressed alpine shrub, with bright green leaves closely imbricate; the branches covered with white tomentum give the plant a variegated appearance; it is most suitable for rockwork. Both species are hardy, easily cultivated in any ordinary soil.

Raoulia eximia, Hook. f. The "Vegetable Sheep." We have tried for some time to acclimatize this curious alpine, but cannot make any encouraging statement as to successful treatment; the specimens still alive do not look flourishing.

Senecio glastifolius, Hook. f. Found plentifully about Port Nicholson; dark green foliaged shrub; grows freely in a sheltered place. Flowers in September.

Senecio sciadophilus, Raoul. This very slender climbing shrub may be found about the bays in Port Cooper. It appears to delight in shady nooks, and may be observed completely covering small trees or shrubs; it blossoms very late, as its yellow flowers may be noticed in June and July.

Senecio elæagnifolius, Hook. f. An alpine shrub of very robust habit and fine foliage; deep green leaves with creamy white tomentum on the under surface; it grows freely, and is hardy enough for any situation. Flowers in February and March. Strikes from cuttings, but not freely.

Senecio Bidwillii, Hook. f. A small slow-growing alpine, with very coriaceous foliage. We have specimens from Arthur's Pass and from above the Rangitata Gorge. It bears transplanting well, and strikes freely from cuttings. An excellent plant for rockwork.

Senecio cassinioides, Hook. f. A slow-growing thickly-foliaged alpine, with small imbricate leaves. It flowers in February and March, its yellow blossoms yielding an agreeable scent, as also do the branches on being rubbed. It is

easily propagated by cuttings, and can be transplanted safely. Like the preceding species, it is hardy enough for any aspect, perhaps the cooler the better.

Brachyglottis repanda, Forst. The well known Pukapuka grows best near the sea, and may be observed in the greatest abundance about Port Nicholson. It is cultivated without any trouble; here it requires some attention to shelter; its large panicles of scented flowers blossom in September and October.

ERICEÆ.

Gaultheria antipoda, Forst. A small prostrate shrub with white flowers, abundant on the Malvern Hills.

Gaultheria rupestris, Br. A shrubby coriaceous-foliaged plant of compact habit; grows freely; suitable for rockwork.

Two other *Gaultheriæ* are very distinct; one, of prostrate habit, bears a round white flower, which is eaten, under the name of "chuckiechuck."

Cyothodes acerosa, Br. A very beautiful shrub, with bright green acerose leaves glaucous underneath. The flowers are creamy white, bell-shaped, very small; the drupe is sometimes coral red, sometimes snow white. The plant is not at all uncommon about the outskirts of the bush. We have noticed that it is a difficult species to remove safely. Like many other natives, the beautiful colour of the shrub depends much on the situation in which it is grown.

Leucopogon fasciculatus, Rich. We have known this shrub mistaken for *Leptospermum ericoides*, to which its foliage bears some resemblance. It bears small creamy flowers; the fruit an orange red drupe. Grows well from seed.

Dracophyllum longifolium, Br. Generally distributed through the hilly country. The singular-looking Grass-tree deserves a place in the shrubbery, if only for the contrast afforded by its grassy-looking brownish green foliage. It is hardy, but of slow growth.

Dracophyllum rosmarinifolium, Forst. An alpine, with reddish lineate leaves stiffer than those of the preceding species; very slow growing, and requires attention as to shade and shelter after removal till new roots are formed. Like many other hard-wooded plants, it prefers an admixture of peat and sand.

MYRSINEÆ.

Mrysine salicina, Heward. Specimens obtained from Port Nicholson are sufficiently hardy to withstand the severities of our southern winter. Its long linear leaf gives a conspicuous appearance to the foliage of this species.

Myrsine Urvillei. Has a very extensive range from the sea beach to a considerable altitude in the mountain ranges. From its hardiness and compact form of growth, it is admirably adapted for a sheltering screen. It can be removed with safety when of a large size.

APOCYNEÆ.

Parsonsia albiflora, Raoul. An elegant climber, with fine foliage of long lanceolate coriaceous leaves; it bears panicles of white scented flowers in spring, quite one of the ornaments of the bushy gullies.

Parsonsia rosea, Raoul. In every way more slender than *P. albiflora;* its blossoms have a rosy tint. Flowers in December.

SOLANEÆ.

Solanum aviculare, Forst. A very common shrub, with dark green foliage and purplish flower; berry orange coloured, edible. Its usefulness as a sheltering plant or nurse for young trees should be mentioned. It is grown from seed without the least trouble; not very hardy, but its usefulness as a nurse-plant, from the rapidity of its growth, can scarcely be overvalued by the planter of exotic *Coniferæ* or any young shrubs or trees requiring shelter.

SCROPHULARINEÆ.

Veronica Dieffenbachii, Benth. This species, from its drooping habit, spreads over a large space of ground in proportion to its height. Our experience leads us to conclude this plant is a shy bloomer; it is easily propagated by cuttings; it thrives well in a light sandy soil.

Veronica macroura, Hook. f. This free-growing species is valuable from its thriving by the sea side.

Veronica salicifolia, Forst. This shrub is familiarly known in this district and throughout the province as Koromiko; it is so universally met with that its claims for cultivation as an ornamental plant are not sufficiently recognized. Flowers throughout the summer.

Veronica ligustrifolia, Cunn. Although we have not flowered this species, young plants obtained from Port Nicholson are growing well under ordinary cultivation.

Veronica Traversii, Hook. f. This species heads an important group of the family; it has a very extensive distribution from the coast line to the Southern Alps. Hardy and of excellent habit, any ordinary soil appears to suit it. We have a very distinct sub-alpine variety, obtained from the rocky banks of a creek in the Ashburton District; it is dwarf in habit, from 2 to 3 feet in height, of spreading form; the leaves large, very coriaceous; flowers abundant; cuttings require a longer time than most other species to form good roots. When better known, perhaps this shrub may be allowed the honours of a distinct species.

Veronica vernicosa, Hook. f. One of the most desirable of the alpine shrubs, whether we consider its compact habit, fine colour, or the readiness with which it submits to, and improves under, cultivation. We have a very distinct variety from the Upper Ashburton District, which is of a dwarfer and less compact form than the plant commonly known by this name; it produces flowers

frequently, throughout the year; before expansion of the petals, the buds exhibit a pinkish tinge; it grows from cuttings readily, and bears abundance of good seed; it thrives in any soil not too dry, and is hardy enough to withstand the cold blast of the bitterest south-wester.

Veronica elliptica, Forst. One of the native plants that is known to have been cultivated in England for some years; it is even mentioned in *Paxton's Botanical Dictionary*. It is often to be observed in gardens and shrubberies, not very hardy perhaps, as its habitat naturally is in sheltered positions near the sea. Its pale lilac-tinged blossoms exhale a delicate perfume. From cuttings it is propagated almost as easily as the willow. It blooms in November.

Veronica diosmæfolia, R. Cunn. This beautiful shrub, said to have been brought from the Bay of Islands, bears such an abundance of lovely white blossoms as should ensure it a sheltered place in every shrubbery.

Veronica Colensoi, Hook. f. This close-growing species attains a height of 3 or 4 feet, with an even rotundity of form that appears almost artificial. It is common in sub-alpine districts. Hooker states it to be variable, and difficult to distinguish from *V. lævis* and *V. Traversii*; we have long remarked variations both in form and colour of the leaf, and also that some individual specimens are much shyer bloomers than others. It will thrive in any ordinary soil, and is hardy enough for any aspect; it should have plenty of air. A variety of this kind we have seen planted for edgings.

Veronica lævis, Benth. The species we know as V. *lævis*, differs from Hooker's description in that the leaves are without petioles. It does not thrive well in very dry soil.

Veronica buxifolia, Benth. Our specimens, obtained from the Westland side of Arthur's Pass, are of dwarf habit, 2 to 3 feet in height; the white flowers, produced abundantly in short racemes at the points of the branchlets, bloom in October. Hardy; it grows well from cuttings.

Veronica carnosula, Hook. f. Native of the Dun Mountain Range. At first glance its leaves appear somewhat to resemble those of *V. elliptica*, but are coriaceous and rounded at the point; its habit is much like that of *V. buxifolia*. It flowers in November. Hardy; it is easily propagated by cuttings.

Veronica pinguifolia, Hook. f. We have cultivated this shrub for many years. The peculiar glaucous colour of this decumbent species, affords a pleasing contrast to many others in the shrubbery. Its habit is pleasing and it blooms freely in any situation, and is not easily lost if once obtained as its lower branches are often found self-rooted.

Veronica pimeleoides, Hook. f. A small shrubby species with a delicate shade of glaucous green; its pretty blue flowers make it a desirable plant for the front of a border or for rockwork. It grows well from cuttings, but must not be planted in a very wet situation.

Veronica pimeleoides, minor. Our specimens of this pretty species were procured from the shingle beds of the Potts River. It is of prostrate habit, sending out rootlets from its trailing branches; the flower, larger than that of the preceding species, is blue; it blooms in November. It is propagated by division; light soil, even if rather sandy, appears best suited to its growth. It is admirably adapted for rockwork.

Veronica lycopodioides, Hook. f. This remarkable looking shrub commences another group of Alpine Veronicas. Nowhere, perhaps, is it to be found in greater abundance than near the swampy creeks that intersect the spurs of Mt. Potts, at an elevation of from 3000 to 4000 feet. It may be said to grow about 2 feet in height, although we have seen specimens of nearly double that measurement. In its young state, with its densely imbricated leaves, it presents a dark green velvety appearance. It flowers in November. It differs from most other species in preferring a deep peaty soil, where it can always obtain a certain amount of moisture; it is most difficult to strike from cuttings, but can be propagated by layers.

Veronica tetrasticha, Hook. f. Quite a fairy-like alpine; although in its native localities amongst crevices of rocks it may be termed decumbent, when growing on a plane surface its habit becomes erect; it is of such slow growth, that a plant which has blossomed for two or three years, has not yet attained 3 inches in height; its peculiarly tinted foliage of silvery green is densely imbricate; its small flowers appear in November; excellent for rockwork; it may be propagated by division.

Veronica Hectori, Hook. f. This much-branched brown-looking alpine, is of upright growth; leaves closely imbricate; above the gorge of the Ashburton there are specimens from 3 to 4 feet in height; very hardy; it grows most freely from cuttings. Flowering season, November.

Veronica salicornioides, Hook. f. A small much-branched alpine, with leaves densely imbricate; colour greenish brown; no specimen has flowered here as yet; it has been cultivated since 1864. Young plants are readily obtained from the lower self-rooted branches.

Veronica cupressoides. The best coloured plant amongst this group of Alpine Veronicas, its fresh deep green foliage and compact shape render it a fitting object either for the shrubbery, or for rockwork, or any place not under trees; it can be moved with safety when of large size; it may be propagated by cuttings, or young plants can be obtained from the lower self-rooted branches.

Veronica Haastii, Hook. f. One of the most curious of the alpine species; it is found on the shingly slips of the Southern Alps. We find this plant difficult to grow, and still more difficult to propagate; we have raised it from seed; in transplanting care must be observed. It flowers in August and September. Light soil most suitable.

Veronica epacridea, Hook. f. This plant bears some resemblance to the last species, but is of very different habit; we have observed on a shingle spit, patches covering many square yards. It flowers in September and October. This prostrate species is well adapted for rockwork; it is easily propagated from cuttings, and is moved without difficulty; light soil most suitable.

Veronica macrantha, Hook. f. Our specimens of this stiff erect-growing shrub were obtained on the mountain's side, several hundred feet above the River Clyde. It is easily grown from cuttings.

Veronica Hulkeana, Muell. This is a fine foliaged species, for which space should be found in a front row of the shrubbery.

Veronica Lavaudiana, Raoul. This shrub is about the best plant that is to be found on the Lyttelton Hills; brownish green foliage, with decumbent self-rooting branches; it is easily propagated, although it does not freely strike from cuttings. Its handsome spikes of bluish white blossoms rival, if they do not surpass in beauty, those of any other native plant in the district.

Veronica Raoulii, Hook. f. More erect-growing than the preceding species; it enjoys a wide distribution; flowers are light mauve colour. This shrub, like the three preceding it, does well in any ordinary soil, without any particular attention being necessary for its cultivation.

Veronica linifolia, Hook. f. This procumbent herbaceous species may be found about the Rangitata; it bears a pretty whitish flower, requires a shady moist situation, and is propagated by division and seed.

Veronica Lyallii, Hook. f. A prostrate-growing species from the River Clyde, with whitish flower; propagated by division or cuttings; thrives in lightish soil, rather moist.

Veronica Bidwillii, Hook. This prostrate species bears a close resemblance to the preceding species. Our specimens were obtained above the gorge of the Ashburton and bear rose-coloured flowers; succeeds under similar treatment to that recommended for the two preceding species.

VERBENACEÆ.

Vitex littoralis, Cunn. We have never seen the Puriri, or New Zealand Teak, growing in Canterbury; as yet, our efforts to acclimatize this valuable tree have been unsuccessful, the winter being too severe. In Mr. Ludlam's beautiful garden, at the Hutt, a fine specimen may be observed growing luxuriantly; we have had the pleasure of seeing it there both in flower and fruit. It appears to require a warm sheltered situation, with moist soil; it is propagated by cuttings easily.

Teucridium parvifolium, Hook. f. A twiggy shrub of very dwarf habit, which may be found commonly growing about Banks' Peninsula; this plant may be trimmed very close; it is suitable for dwarf edgings; flowering season

in November and December. Any rather dry soil suits it, but it appears to thrive best on a slope or rocky hill-side; can be removed easily.

Myoporum lætum, Forst. A shore-loving tree or shrub; its rapid growth and handsome foliage render it valuable for screening the nursery of young trees or shelter of almost any kind, but it is not sufficiently hardy to encounter very severe frosts without injury; it bears pruning well; if neglected in this respect its robust habit quickly changes the densely-foliaged shrub into a tree, with its lower part furnished with lateral twigs, the bareness of which detract from its beauty; it may be headed to within a few inches of the ground; in transplanting, a dull day should be chosen for the purpose, as the young plants are apt to flag. Its pale flowers are succeeded by a purple drupe; it is subject to scale.

POLYGONEÆ.

Muhlenbeckia adpressa, Lab. A fast-growing twining climber, its rambling habit covers a considerable space; its foliage of bright green cordate leaves may be found useful for concealing some shabby object or unsightly corner; its spikes of blossoms are very pretty and graceful, they may be observed during several months of summer; rather damp soil most suitable.

LAURINEÆ.

Nesodaphne Taraire, Hook. f. Small plants obtained from the neighbourhood of Wellington appear to thrive very well. In a report furnished to the House of Representatives, 1869, *N. Tawa* is alleged to be found in Oxford Bush, in this province.

MONIMIACEÆ.

Atherosperma Novæ Zelandiæ, Hook. f. Small plants of this fine tree look thriving.

Hedycarya dentata, Forst. This beautiful evergreen shrub is sometimes called the Holly, from its deep green glabrous foliage and abundant clusters of red berries; from the character of its roots, not unlike those of *Drimys*, it can be removed with safety if ordinary care be taken; although found in sheltered spots, it flourishes with a south-west aspect.

PROTEACEÆ.

Knightia excelsa. Small plants of this lofty tree are thriving.

THYMELEÆ.

Pimelea Traversii, Hook. f. Our specimens of this dwarf glabrous-leafed alpine were obtained some distance above the Rangitata Gorge; it is erect in habit, bears pinkish white flowers; it thrives in stiff clay soil, and it is very difficult to remove without injury; it is readily raised from seed.

Pimelea prostrata, Vahl. Common amongst the Malvern Hills; of prostrate

habit; its trailing branches somewhat radiate; its creamy white flowers are fragrant, and succeeded by greenish white fruit; it does well in stiff soil; from its long tap root it is difficult to remove with safety.

CUPULIFERÆ.

Fagus Menziesii, Hook. f. As is well known, the *Fagus* family occupy one of the most important positions amongst the forest trees of the Middle Island; not unlike the kauri in respect of being gregarious, whole bushes may be observed composed almost wholly of *Fagus*. Four species are recognized by botanists; these are known to settlers by the names of Black, White, or Red *Birch*, not Beech, which would be their more correct designation. Specimens of *F. Menziesii*, obtained from the head waters of the Rakaia, are making fair growth.

Fagus fusca, Hook. f. Not very common in Banks' Peninsula. Young plants look well.

Fagus Solandri, Hook. f. In some few places on Banks' Peninsula this well known tree may yet be found growing to a large size; some we measured were 14 feet in circumference.

Fagus Cliffortioides, Hook. f. The Black Birch of the Malvern Hills, etc.

All the *Fagi* grow well in rather strong soil, can be easily removed, and grow freely from seed; they are hardy, and their foliage forms a capital contrast in shrubberies and plantations.

PIPERACEÆ.

Piper excelsum, Forst. An aromatic shrub with bright green cordate leaves, the fruit a long-shaped yellow berry. This plant requires a sheltered and rather moist situation; it is well worthy of cultivation; it can be removed without difficulty.

CONIFERÆ.

The conditions necessary to the successful cultivation of New Zealand *Coniferæ* differ much from those which mark the usual routine of fine culture; a certain degree of moist shade and shelter is requisite; that this is absolutely necessary anyone can ascertain who will take the trouble of observing the natural habits of the various species, and the peculiar conditions attending the growth of young plants. As an instance, the group of *Podocarpi* may be mentioned, the seedlings and young plants are mostly to be found growing under the moist shelter of a variety of shrubby undergrowth, of which the Ngaio frequently forms a large proportion; here they may be said to hide themselves, as it were, from the cold blasts of winter and the scorching rays of the noontide sun in summer time, presenting lively green shades of foliage, seldom, if ever, to be met with in an open exposure. In one word, if our native *Coniferæ* are treated in the same manner under which exotic pines flourish, the result will be disappointment and perhaps disgust, as the number

of casualties are enumerated, the occurrence of which might be fairly attributed to drying off.

Dammara australis, Lambert. This noble tree is, *par excellence*, the Queen of the New Zealand forests, as it has been aptly termed. In this southern latitude, as yet, we have been unable to acclimatize it successfully; it is of slow growth even at the Hutt; we imagine that judging from the extreme localization of this magnificent *Conifer*, its cultivation is attended with difficulty; probably certain incidents of soil, shelter, and aspect, are indispensable to success. According to Paxton, the Kauri reaches the height of 400 feet.

Libocedrus Doniana, Endl. This beautiful *Conifer* may still be found in Banks' Peninsula, though rare; in the Otira Gorge it may be found in great numbers; young plants can be removed safely, but require shade and shelter; some are growing here in quite exposed situations, but it should be noted that numbers have died from want of shelter; the handsome foliage of this *Conifer* (not very unlike that of *Arbor vitæ*) will repay the grower for extra care and attention; rich soil, not too wet, appears most suitable.

Libocedrus Bidwillii, Hook. We have observed some fine specimens growing on Mounts Sinclair and Fitzgerald; in its habit of growth it preserves a rounder form than that of the preceding species.

Podocarpus ferruginea, Don. This excellent timber tree, called the Miro, seems to flourish both in valleys and on hill-sides; shade and shelter is requisite for young plants; soil, if moist, must not be absolutely wet.

Podocarpus nivalis, Hook. f. One of the hardy inhabitants of the Southern Alps, where it may be observed battling successfully with a rigorous climate; we have rarely noticed it with a straight stem; plants of this slow-growing species are greener in foliage than specimens of *P. Totara*, the leaf also is much shorter; however hardy its constitution may be, young plants require shelter; they may be transplanted safely without much trouble.

Podocarpus Totara, A. Cunn. Well known as one of the most valuable of the forest trees of the country. This species does well, and makes rapid growth under cultivation; it may be transplanted without difficulty, can be propagated by cuttings, for which purpose care should be taken to select slips from *leading* shoots. A variety of Totara has broader leaves, thinner bark, and wood which is said by bushmen to be of tougher quality.

Podocarpus spicata, Br. Mai or Mataii, the well known Black Pine, which settlers find useful for so many purposes. Robust as the tree becomes in its adult state, we have experienced great difficulty in cultivating young plants; without shade or shelter it seems an almost hopeless undertaking.

Podocarpus dacrydioides, Rich. Kahikatea, or White Pine, luxuriates in deep alluvial soil in shady situations; if exposed, the foliage exchanges its green hue for dull brown tints; in a dry position its growth is exceedingly slow; can be removed with safety; grows well from seed.

Dacrydium cupressinum, Soland. The graceful drooping foliage of the Rimu is, perhaps, unsurpassed in beauty by that of any other native *Conifer;* it requires a moist and rather sandy soil, with abundance of shelter; it should be removed carefully, in order that the rootlets may not become too dry.

Dacrydium Colensoi, Hook. In very exposed positions this tree or shrub maintains a dense habit of growth, perhaps 6 to 10 feet in height; in more favoured situations it approaches the dimensions of a fair-sized tree.

Phyllocladus trichomanoides, Don. This singular looking North Island pine grows freely; it merits a place in plantations of forest trees from the contrast it affords by its curious purplish-tinged foliage.

Phyllocladus alpinus, Hook. f. In its native state it withstands the rigour of most inclement winter seasons; its close growth, conical form, and the silvery appearance of its foliage, make this species a most interesting object when seen amongst the rocks of its rugged mountain home. It is slow growing; may be removed without difficulty; can be propagated by cuttings, or may be increased by layers.

MONOCOTYLEDONS.

LILIACEÆ.

Rhipogonum scandens, Forst. This obstructive climber, which so often delays the progress of the wanderer through the bush, is not unattractive with its dark coriaceous foliage and clusters of scarlet berries; excellent baskets can be manufactured from its stems, also handsome walking canes that would be prized in Europe; we believe there is no better material for ships' fenders than is supplied by the stems of the Supple-jack.

Cordyline australis, Hook. f. The Ti Palm, or Cabbage Tree, is too well known to need description; as a screen hedge it affords excellent shelter; grows freely and rapidly; can be transplanted without any difficulty; its huge spikes of flowers are very fragrant, and might be made to yield a valuable perfume; it delights in rich soil; its presence is said to indicate moisture.

Cordyline indivisa, Kunth. This *Cordyline*, generally about 10 to 12 feet in height when it is met with on Banks' Peninsula, yet specimens are occasionally observed reaching from 20 to 25 feet; grows well in fair soil, but is liable to die off in its young state if not well attended to; it requires plenty of room and air.

Cordyline, sp. The Titawhiti, of the Whanganui tribes, grows here very well; it has a dark green leaf, and throws off young plants more freely than some of the other species.

Phormium tenax, Forst. The cultivation of native Flax has already been so often dwelt upon, that any remarks on the subject must be quite unnecessary, more especially as the whole subject has been exhaustively treated by the Report of the Flax Commission. A variegated variety, differing somewhat from any other with which we are acquainted, was found growing near the beach in Port Cooper.

Art. XXXII.—*On the Natural History Collections in the Otago Museum.* By J. S. Webb.

[*Read before the Otago Institute, January* 11, 1870.]

I believe that there are still a great many persons who look upon the pursuit of any department of natural history, which does not directly serve industrial purposes, as a frivolous occupation for adults. From my own observation, I should be disposed to say that this feeling is even more prevalent in the colonies than at home. I make this remark as specially applicable to the working men, amongst whom I was accustomed in my native town to meet many ardent students of nature. But it is true, I believe, of all classes, and I think the fact is much to be regretted, in view of the large number of young people who are growing up around us, for whom the pursuit of natural history would furnish one of the most improving and delightful occupations for their leisure hours which can be devised. I hope that the formation of this Society will have considerable effect in promoting the study of nature amongst us. Those who are indifferent to it, are so from want of information, both as to itself and as to its tendencies.

Irrespective of its share—a great and noble one—in the work of civilization and progress, the study of natural history brings with it, to all who embrace it, its own special gifts for the individual. Nothing is more influential in the formation and maintenance of healthful habits—it affords a relaxation both to body and mind, which never enervates; it is a pastime which leaves no languor behind it. It is much more than all this; it is a training for the mental faculties unsurpassed by any other. It is not alone the reasoning faculties, the memory, the powers of observation, and the capacity for methodical habits, whose development it subserves. It is on the highest part of our being that it takes surest hold. The poetic and conceptive faculties know no nursery like that of nature. The passions and aspirations of the heart of man find nowhere so calm a monitor, so pure and perfect an inspirer. No avenues lead more directly up to what is Highest, both on Earth and in Heaven, than hers. Knowing all this by my own experience, and from the testimony of so many great and good men, I feel the utmost concern that the youth of this country should lack so many of those facilities and incentives to the study of nature, by which in more favoured lands the young are allured to it. This is my apology for bringing before the Institute a paper exclusively devoted to natural history subjects.

The proper title of my paper would perhaps be, "Work for the Institute in the field of Natural History." In laying before you a series of lists of what is wanting to render the Natural History department of our Museum a fair representation of the Flora and Fauna of Otago, my special object is to solicit

the assistance of all who are able to render it, whether members of the Institute or not, in the work of completing the collections which have been so creditably begun; and to explain as far as I am able in what directions the first efforts should be made. Did this work only involve the gathering of specimens, I should have felt more diffidence in taking up the time of the meeting with what I have to say. It is the collection of facts that is of the most importance. An array of dried plants or stuffed animals, though brought together with much labour, and arranged with elaborate care and the highest skill, would of itself be of little more value than a peep-show, if nothing were known of the plants and the animals, their homes and their ways, except what could be gathered by the eye from the collection itself. In the observation of the conditions and habits of the world of life around him, there is a great field, and a very interesting one, open to the student of nature in Otago. I sincerely hope that, under the auspices of this Institute, much will be gathered in it, and that what is thus gathered will be made known through our *Transactious*, to all who delight in such information.

THE HERBARIUM.

I shall confine myself, in this paper, to some remarks on the Botanical Collection in the Museum. I give precedence to it because I believe there are in Otago more students of botany than of any other branch of natural history, and because the collection itself is a large and important one. At the same time, this is the only department of the science as to which we have any means of information on matters connected with our own province, beyond the walls of the Museum itself. A good deal of information about the natural history of Otago, lies scattered over the world of books; but it is altogether inaccessible to those who are here on the spot. The botany of the province is an exception to this rule. Besides the information contained in Dr. Hooker's *Handbook of the New Zealand Flora*, there is a very useful paper on the Botany of Otago, by Mr. Buchanan, to be found among the other Exhibition Essays, in the volume of *Transactions of the New Zealand Institute* for the year 1868. Some important notes on the same subject have also been published in a separate form, by Dr. Lauder Lindsay, for, though the latter work is entitled *Contributions to New Zealand Botany*, its real subject is the Flora of Otago only.

I should say at the outset, that there are many bulky plants mentioned in these lists, as required for the Museum, which cannot be properly represented by specimens, such as a herbarium is usually composed of. It would be very well if drawings of most of these could be got; and, at any rate, the flowering heads and fruits should be obtained. A series of specimens of the seeds and fruits of most of our plants is wanted. These specimens of plants in the Museum were gathered and prepared by Mr. Buchanan, I need hardly say,

therefore, that they are mostly very good and complete. Only a part of them, however, include samples of the fruit, or of any but the flowering stage of the plants themselves.

The first thing to be noted in regard to the Herbarium, is the fact that it is essentially a collection of western plants, made, I presume, during the expeditions of the Geological Survey Staff to the Lake District and West Coast. With the exception of thirteen plants named in one of the lists appended to this paper,* all the specimens in the Museum are of species which occur in (what Mr. Buchanan has called) the western region of the province—*i. e.*, the country lying to the west and south of the course of the Molyneux River. A great majority of the plants which belong to the western region are also found on this side of the province. But a considerable number of those most common in the immediate neighbourhood of Dunedin, are unrepresented in the Museum. This fact alone deprives the collection of much of its value for the young botanist, who, however assiduous he may be, cannot at the outset of his studies make any rapid progress without the assistance of a pretty complete collection of the plants he first makes acquaintance with. A still more important point in which the Museum Herbarium is wanting, is in duplicate specimens. The plants, as at present exhibited, are not available for study. As against these disadvantages, we may congratulate ourselves that a majority of the rarer plants are represented by beautifully prepared specimens, so that we may hope, in a short space of time, to fill up most of the gaps which do occur, if anything like a proper effort is made.

Taking the catalogues of Buchanan and Lindsay as representing what is known of the botany of Otago, we shall find that there are 196 plants unrepresented in the Museum Herbarium. In the lists I now present to the Institute I have divided these plants as follows:—Taking first Mr. Buchanan's list as a guide, we find fourteen plants peculiar to the eastern region, thirty-four peculiar to the western region, and 137 common to both regions, wanting in the Museum. To these I add a further list of eleven plants (making a total of 194) gathered here by Dr. Lindsay, which appear to have escaped the observations of Dr. Hector and Mr. Buchanan. These are neither represented in the Museum nor mentioned in Mr. Buchanan's paper on the Botany of the Province. This fact corroborates what I have endeavoured to impress on my friends who are botanists, viz., that there is ample scope for the discovery of new forms in Otago. I may add the fact that there are growing in the garden of my friend, our respected Vice-President, Mr. Beverly, two plants, one from Preservation Inlet, and the other found by himself so near Dunedin as School Creek, which do not appear to have been yet described—which are new, not merely to the province, but to the colony. I mention these facts, because the

* No lists have been forwarded for publication.—Ed.

laudable ambition to be the first discoverer of some new natural form, has always been one of the strongest incentives to the earnest student of nature.

It is not, however, the mere completion of our roll of species that is wanted. A very large number of New Zealand plants are highly variable in their character. To obtain a thorough insight into the limits of this variation, and to discover what we can of its probable causes, forms a far more attractive and interesting sphere of labour than the mere collection and determination of species. As an illustration of this variation, I have brought with me, four different forms of one of our commonest plants. The specimens of the common "lawyer," or Tataramoa (*Rubus australis*), exhibited, are referred by botanists to one species, and it is stated that passage-forms occur, connecting all these apparently different plants. It will be highly interesting to obtain complete series of such passage-forms, if they do indeed exist, with information as to the exact localities which they affect. In regard to this particular shrub, I must confess to some incredulity, in spite of the concurrent testimony of botanists. The strangely different forms marked 1, 2, 3, and 4, have been gathered close to one another on the same soil, growing under the same aspect, being, in fact, produced under identical circumstances. Many problems of this sort lie before the botanist in New Zealand. I do not propose to detain you by instancing the more prominent cases of excessive variation which characterize the flora of New Zealand. There is a very interesting paper, by Mr. Travers, in the first volume of the *Transactions of the New Zealand Institute* on the subject, and Dr. Lindsay's *Contributions to New Zealand Botany* is full of remarks upon it. The latter gives (*Contributions to New Zealand Botany*, p. 46) a long list of genera, which are exceedingly variable, including more than a hundred different species of plants; and says of them, that they present "such a continuity of variation—such chain of passage-form connecting varieties and species—so great a variation of the individual from the type, that limitation at all is either set at defiance, or at least the limits assigned in published floras are much too trivial, precise, and minute."

In connection with this subject, some of the geological features of this island are worthy of notice. It appears to be a generally admitted theory with our geologists, that at a comparatively recent period the elevation of the land which now forms the eastern portion of New Zealand was accompanied by depression of the western area. Something like a general falling over to the westward is indicated, bringing the tertiary formations of the eastern sea-board over the level of the sea. Accepting this theory as the best explanation of observed facts, an interesting question arises for the botanist: how far are these endless variations of New Zealand plants in the central and eastern areas, due to the fact that, though directly descended from those of the western region, they have had to contend with natural circumstances altogether different

from those which prevailed before these great changes of the surface features of the land were achieved? Is not this great variability and indication of a transitional epoch such as, so far as we know, no area of equal extent on the surface of the globe offers us equal facilities for studying? These are questions to which we need not despair of obtaining answers if the peculiarities of our own local flora are assiduously studied, and the results obtained brought together for careful comparison. I leave it to those who have more intimate knowledge of New Zealand botany to follow up an idea which I only venture to throw out as an incentive to study. If by thus stating a theory I succeed in stimulating the lovers of nature in Otago to closer and wider observations, and induce them to send their notes to be read at our meetings, the information obtained will be equally welcome, whether it support or destroy the hypothesis. In connection with this part of my subject, the study of our fossil flora will be of much importance, and I shall take the opportunity of referring to it again when I bring up my remarks on the geological department of the Museum.

One more point I will take leave to dwell upon before concluding. As I have already stated, I think it highly improbable that the list of Otago plants is at all nearly closed. Mr. Buchanan, in the paper already referred to, catalogues 507 species of Otago *Phænogams* (flowering plants). This is little more than half the number already assigned to New Zealand by botanists. Wide as is the geographical range of these islands, it is highly improbable that so many as 500 species do not range throughout this extent, in localities suitable for their growth. It is, on the other hand, probable that many entirely new species will yet reward the diligence of our local observers. Dr. Lyall appears to have reported the collection of several plants on the West Coast which have not since been gathered there by botanists. No settlement having as yet been planted there, this fact can hardly be deemed suspicious. But the list which accompanies this paper, of flowering plants collected within the older settled districts of this province by Dr. Lauder Lindsay, during a hurried visit in 1861, which have apparently escaped the notice of such indefatigable observers as Hector and Buchanan, offers us still stronger evidence that there is yet plenty of work to be done by local botanists, before we can venture to say what is to be found in Otago and what is not.*

Mr. Buchanan has added greatly to the value of his catalogue of plants by affixing to each species letters and numbers indicating (1) the elevation at which it is found, (2) whether it belongs to the east or west region of the province or to both, and (3) its relative prevalence or scarcity. It would be matter for wonder if all his determinations of these several particulars should remain unchallenged. It is possible, too, that clerical or typographical errors may exist amongst these indices. It will be the duty of local observers

---

* See *Proceedings*, p. 58.—Ed.

carefully to check his conclusions. I have been induced to refer particularly to this by the fact that I find one shrub, *Melicope simplex*—not at all uncommon about Dunedin—marked by Mr. Buchanan with the figure which indicates "the mere occurrence of a few individuals of the species." If his catalogue were carefully analysed by every naturalist in the province, it can hardly be doubted that information on all the points I have referred to in this paper would be forthcoming. I do not think that the Institute, in the first year of its existence, could more usefully promote this one amongst the studies which it has taken under its wing, than by collecting such information and placing it at the disposal of Mr. Buchanan, for the purpose of publishing, under the auspices of the Institute, a revised edition of his valuable essay and catalogue.

Art. XXXIII.—*On some New Species and Varieties of New Zealand Plants.*

By John Buchanan, of the Geological Survey Department.

[*Read before the Wellington Philosophical Society, June* 25, 1870.]

On a supposed Hybrid Acæna.

An apparent Hybrid *Acæna* has been observed in the neighbourhood of Wellington, partaking the characters of *Acæna Sanguisorbæ*, an indigenous species, and *Acæna ovina*, an introduced species from Australia, both found in the same locality.

The first of these having the flowers in globose heads, is constant to this character over New Zealand, whilst the Australian species has the flowers arranged in long obovate spikes.

The supposed hybrid shows below the globose heads several small clusters of flowers, axillary to bracts on the peduncle, thus becoming an intermediate form.

If the theory of hybridization prove unsuitable, this form must be accepted as a recent variation from *Acæna Sanguisorbæ*, as it has not been noticed previously; the presence of the two species on the same spot is, however, a remarkable coincidence.

Collected by J. Buchanan, on Mount Victoria, Wellington.

[*Read before the Wellington Philosophical Society, October* 22, 1870.]

Dichondra brevifolia, Buchanan. n. s.

A small minute-leaved, creeping, tufted, glabrous herb. Leaves shortly petiolate, reniform, $\frac{1}{8}$ inch broad, entire, glabrous. Scapes 1 inch long, pubescent or glabrous, four times longer than the leaves. Flowers solitary; corolla

longer than the calyx, the latter ciliate or silky. Other characters of flowers and fruit the same as *D. repens*. Capsule long, silky.

Hab. — Popotunoa, Otago. Pastures, in swampy places, mixed with *D. repens*.

This distinct little species is easily distinguished from *D. repens* by its much smaller size and uniform-sized leaves, its long scapes, and nearly glabrous character.

Collected by J. Buchanan.

Aristotelia erecta, Buchanan. n. s.

A small, rigid, erect, opposite-branched shrub tree, with reddish brown bark, ultimate twigs pubescent. Leaves on short pubescent petioles, erect, oblong lanceolate, 2–2½ inches long, opposite, finely and regularly serrate, pubescent on midrib. Racemes ⅝ inch long, erect, axillary in opposite pairs, scattered all over the branches; peduncles, pedicels, and calyx pubescent. Flowers few, small, diœcious, in opposite pairs, with large leafy bracts; male flowers not seen, petals of female flower entire, sometimes lobed, a little longer than the woolly fringed sepals. Fruit not seen.

Hab.—Lake District, Otago, 1200 ft. alt.; Wyndham, Otago, 800 ft. alt., Patea, Wellington, 1000 ft. alt.

Collected by John Buchanan in the South Island, and Dr. Hector in the North Island.

This species is not uncommon, but easily overlooked when not in flower; it often retains the lobulate form of leaf till nearly full grown, and has then proved always a puzzling plant.

Arrangement of the New Zealand Species of Aristotelia, *to show the position of the New Species,* Aristotelia erecta.

(a.) *Racemes aggregated.*

1. Leaves membranous, pubescent, 3–5 inches long. Racemes aggregated on the branches in large masses of flowers. Berries large, black. Description otherwise as in *Handbook*.	*Aristotelia racemosa.*
Leaves membranous, pubescent only on the principal veins, 3–5 inches long. Racemes aggregated in lesser masses of flowers than the last. Berries small, red.	Sub-species, *Colensoi.*

(b.) *Racemes scattered.*

2. Leaves smaller, 2–2½ inches long, glabrous except on the midrib, lobulate on young plants. Racemes small, scattered over the branches.	*Aristotelia erecta.*
Branches tortuous. Leaves very small and coriaceous. Racemes very small, or reduced to single flowers.	Sub-species, *fruticosa.*

[*Read before the Wellington Philosophical Society, November* 12, 1870.]

Undescribed Varieties of Claytonia Australasica, *Hook. f.*

Considerable difficulty has been experienced by collectors in determining this wide-spread little alpine, from the description in the New Zealand *Handbook*, a racemose variety being much more common than the described species.

The two following varieties are constant in large patches, and perhaps are so also over certain districts exclusively; the variations may therefore be considered as due to different conditions of growth only.

Claytonia Australasica, Hook. f. A glabrous, slender, creeping, succulent, tender herb, rooting at each node, where leaves and scapes ascend. Leaves solitary or in distant pairs, terete, and thickened upwards, obtuse, $\frac{1}{3}$–2 in. long, pale green, the petioles dilating into membranous *sheaths* at the base. Scapes axillary, solitary, 1-flowered, erect, usually shorter than the leaves. Flowers pure white, variable in size, $\frac{1}{4}$–$\frac{3}{8}$ in. diameter. *Capsules 3-valved, 3-seeded. Seeds large, shining, black.*

Hab.—Lammermoors, Otago, 3000 ft.; Mount Alta, Otago, 5000 ft.

Collected by J. Buchanan.

Var. a. *biflora.* Leaves fasciculate and single on the same plant, 1 in. long. Flowers in pairs, or sometimes two pairs on the same scape, shorter than the leaves.

Hab.—Mount Egmont, 6000 ft.

Collected by J. Buchanan.

Var. b. *racemosa.* Leaves fasciculate and in pairs on the same plant, 2 in. long. Racemes of 4–7 flowers, pink, much longer than the leaves. Bracts large, membranous.

Hab.—Dun Mountain, 4000 ft.

Collected by Henry H. Travers.

This very showy variety, with its mass of pink flowers, is worthy of cultivation.

Cyperus gracilis, Buchanan. n. s.

A flaccid pale green glabrous leafy plant, 1–2 ft. high. Culm sharply 3-angled, grooved, 1-10th in. diameter. Leaves shorter than the culms, keeled, margins almost smooth, sheathing part with white membranous border. Involucral leaves 3–6 in. long. Umbels of 6–8 short rays, $\frac{1}{4}$–1 in. long, springing from nearly the same base as the involucral leaves, and forming dense round masses. Spikelets arranged in globose umbels $\frac{1}{2}$ in. long, pale dull green. Glumes ovate, acuminate, with white membranous border. Nut 3-angled, pale whitish green. Style persistent.

Hab.—Swampy ground in the Hutt Valley, Wellington.

Collected by J. Buchanan.

The slender habit, circular umbels, and pale colour, distinguish this at once from *Cyperus ustulatus*.

Isolepis globosa, Buchanan. n. s.

Culms erect, 1–2 ft. high. Spikelets aggregated in dense globose heads immediately below the very obtuse tip of the culm, very narrow, linear, $\frac{1}{3}$–$\frac{1}{2}$ in. long. Proliferous culms 2–4 inches high, sheathed at the base, and bearing smaller heads of linear spikelets. Glumes oblong, obtuse, in the proliferous heads acute. Nut 3-gonous, pale, smooth, not dotted.

Hab.—Karori Hills, Wellington, where it shows bright green patches in damp hollows.

The long linear spikelets distinguish this from the other New Zealand species.

Collected by J. Buchanan.

Sellieria fasciculata, Buchanan. n. s.

An erect small shrub. Leaves $\frac{1}{3}$ in. long, obovate, coriaceous, nerveless, fasciculate on alternate short branches. Flowers on short peduncles, 3–4, terminal on the branches, axillary to the uppermost leaves. Peduncles $\frac{1}{8}$ in. long, with two subulate opposite bracts above the middle.

Collected by Dr. Haast at Weka Pass, Canterbury.

The shrubby habit of this plant allies it more to *Scævola*, but for several other characters, which place it with *Sellieria* and nearest to *S. radicans*.

Clematis afoliata, Buchanan. n. s.

A rigid wiry-branched climber. Branches finely grooved, glabrous, whole plant leafless, or leaves reduced to opposite tendrils. Male flowers $\frac{3}{4}$ in. diameter, solitary, terminal, on produced peduncles at the ends of the branches. Peduncles 1 in. long, silky, with one bract at base, in the axils of the last pair of tendrils. Sepals 4, greenish white, linear oblong, acute, silky. Anthers 8–12, linear obtuse. Female flowers few, 2–4, in the axils of branches or tendrils, in single or opposite pairs. Peduncles $\frac{3}{4}$–1 in. long, silky, with an opposite pair of bracts on the middle and bracteate at the base. Achenes silky, with long feathery awns.

This well marked species is often found as an unsupported shrub, weaving and intertwining its stiff branches on themselves, and forming upright dense masses.

Hab.—Waitaki Valley, Otago, and Marlborough. (See *Trans. N. Z. Inst.*, Vol. i.)

Collected by J. Buchanan.

Olearia capillaris, Buchanan. n. s.

A small slender-branched shrub. Branches, panicles, and petioles covered with closely appressed buff tomentum. Leaves ¾–1 in. long, membranous ovate, obtuse or acuminate, nearly entire, covered below with silvery white tomentum, young leaves silky above. Heads few, in lax open corymbs. Florets 8–12. Pedicels long, very narrow, hair-like. Panicles of 3–5 heads, sometimes 5 in. long. Achene with a few scattered forked hairs.

Closely related to *O. nitida*, Hook. f.

Hab.—Nelson Mountains, altitude 4000 feet.

Collected by Henry H. Travers.

Melicope Mantellii, Buchanan. n. s.

A glabrous small tree, 12–15 ft. high, branches slender, dark brown. Leaves dark green, opposite, 3-foliolate, the side folia sometimes dropping off, leaflets 1–1½ in. long, oblong or obovate, rounded at point, crenulate or entire, flat, often overlapping on their inner sides. Petioles shorter than the leaves, narrowly winged with a groove on the upper surface. Flowers small, white or pale greenish yellow, in small axillary cymes, which are often reduced to three flowers. Petals linear oblong, reflexed when in full flower. Ovary hirsute. Carpels scarcely coriaceous, few veined, pellucid dotted, punctate. Flowers and fruit otherwise the same as *Melicope simplex*, to which, Dr. Hooker says, it is closely allied.

Hab.—Common in the neighbourhood of Wellington, associated with *Melicope ternata* and *Melicope simplex*. From the first of these it is easily distinguished by the darker green foliage, smaller flat leaves, hirsute carpels, and smaller fruit; and from the latter by its larger ternate leaves, flowers, and fruit.

Collected in Wellington and Auckland by J. Buchanan.

Coprosma serrulata, Hook. n. s.

A small upright unbranched shrub, 10–18 in. high. Leaves large, coriaceous, 1–1½ in. long, broadly obovate, round at tip, serrulate, tapering into a very short stout petiole. Specimens in the Museum Herbarium not in flower. Fruit apparently sessile, hidden amongst the leaves.

Hab.—Sub-alpine altitudes of Otago and Nelson, where it is usually found growing among grass. Lower part of the stem blanched white.

Dr. Hooker, in a letter to Dr. Hector, remarks,—"This plant is a botanical curiosity, as being the only species in this large genus with serrated leaves."

Collected in Otago by J. Buchanan, 1865, and by Dr. Hector in Nelson, 1869.

Art. XXXIV.—*On Recent Changes in the Nomenclature of the New Zealand Ferns.* By John D. Enys.

[Read before the Philosophical Institute of Canterbury, October 5, 1870.]

In the *Synopsis Filicum* of the late Sir W. J. Hooker and J. G. Baker (London: 1868), a considerable number of changes have been made in the names of the Ferns of New Zealand, given in Dr. J. D. Hooker's *Handbook of the New Zealand Flora*, 1864, and as these newly adopted names will be in future accepted and employed by botanists, I have drawn up the following list for the assistance of our local collectors.

It will be observed that the list also includes some new species, which have been added to the Flora of the country since the publication of the first volume of the *Handbook*, although some of them are mentioned in the "Additions, Corrections, etc.," p. 722, of the second volume.

These new species are,—

Gleichenia dichotoma,—from the Hot-springs of Karapiti and Rotomahana.

Hymenophyllum ciliatum,—discovered by W. T. L. Travers, on the Nelson mountains.

Lomaria dura,—Chatham Islands.

Nephrodium unitum,—Hot-springs, North Island.

As regards *Hymenophyllum æruginosum*, Dr. Hooker does not agree with his father's opinion, and retains the name *æruginosum*, as he says that the plant from Tristan d'Acunha is not distinct from that found in New Zealand.

In the *Synopsis*, a new *Trichomanes* is described, and called *Armstrongii*, after the discoverer, a son of the Government Gardener of Canterbury.

[The list given by the author of this paper was imperfect, and has therefore been included in a complete corrected list of all New Zealand Ferns, which has been printed separately for the convenience of collectors, and issued with Part 2 of the *Proceedings*, 1870.—Ed.]

Art. XXXV.—*On some* Algæ *from the Chatham Islands.* By Professor J. Agardh, of Lund. Communicated by F. von Mueller, C.M.G., M.D., Ph.D., F.R.S.

[Read before the Wellington Philosophical Society, October 22, 1870.]

In submitting this brief notice of the *Algæ*, collected by Mr. Travers in the Chatham Islands, I have a double object in view. I wished to place on record the results of the examination of these species, as emanating from a philosopher, who, as the worthy descendant of a great investigator in phytology

(Bishop Agardh), has long been illustrious; and I did this with all the more readiness, as neither in Dr. J. D. Hooker's *Handbook* on New Zealand plants, nor in my little work on the *Vegetation of the Chatham Islands*, specific notes on any of the *Algæ* of that group are contained. Furthermore, I hope to encourage renewed and extended enquiries in this direction, by drawing attention to the fact, that one-third of the few *Algæ* hitherto collected in the Chatham group, augment actually the long list of species already discovered at the main islands of New Zealand. It seems thus evident, that any methodic search after such plants, throughout all seasons, will be rewarded with many new disclosures of this portion of the oceanic vegetation.

The species hitherto unrecorded from any part of New Zealand, and mostly new to science, are *Hymenocladia lanceolata, Landsboroughia myricifolia, Cystophora scalaris, C. dissecta, Amphiroa Wardii, Palyripha nia Muelleriana.* The first of these plants introduces even a new genus into the vegetation of New Zealand, of which latter that of the Chatham Islands must be regarded as a mere offshoot. The species are arranged according to Harvey's *Index Generum Algarum*, which that lamented great observer promulgated in 1860. Omitted from the list is *Conferva Darwinii*, to which plant I have already referred in the preface to the *Vegetation of the Chatham Islands.*

F. v. M.

Melbourne Bot. Gardens,
September, 1870.

1. *Carpophyllum phyllanthus*, J. Hook. et Harv., in *London Journ. of Bot.*, iv., 526. Travers' Coll., 112.
2. *Landsboroughia myricifolia*, J. Agardh. Travers' Coll., 110. I have ventured to write the generic name in congruity with that of the Rev. Dr. Landsborough (the father of the Australian explorer), to whom the genus was dedicated, although the late Prof. Harvey, for the sake of brevity, called it *Landsburgia.* Though such changes have been adopted in many other cases (for instance, in the dedication of the genus *Goodenia*, by Sir James Smith, to Bishop Goodenough), it is evident that such alterations in the name deprive the dedication of all real meaning. If such change is adopted for distinction between a zoologic and phytologic genus, it would appear far better to abandon one of the two altogether.
3. *Cystophora scalaris*, J. Agardh. Travers' Coll., 108.
4. „ *dissecta*, J. Agardh. Travers' Coll., 109.
5. *Ecklonia radiata*, J. Agardh. *Spec. Gen. et Ord. Algæ*, i., 146. Travers' Coll., 105.
6. *Zonaria Turneriana*, J. Ag. (*Z. interrupta*, Ag. *Sp.*, i., 137.) Travers' Coll., 100.

7. *Dictyota Kunthii*, Ag., in J. Agardh *Spec. Gen. et Ord. Alg.*, i., 94. Travers' Coll., 101.
8. *Sphacelaria paniculata*, Suhy, in Regen's b. *Flora, Bot. Zeitung*, 1840, 278. Travers' Coll., 92.
9. *Polysiphonia Muelleriana*, J. Ag. Travers' Coll., 115.
10. *Amphiroa Wardii*, Harv. Travers' Coll., 89.
11. *Pterocladia lucida*, J. Ag. *Spec. Gen. et Ord. Alg.*, ii., 483. Travers' Coll., 99.
12. *Hymenocladia lanceolata*, J. Ag. Travers' Coll., 98 and 114.
13. *Rhodymenia corallina*, Greville, in Hook. *Lond. Journ. of Bot.*, iv., 544. Travers' Coll., 106.
14. *Callophyllis Hombroniana*, Kuetz. *Spec. Alg.*, 746. Travers' Coll., 102.
15. *Gigartina Radula*, J. Ag. *Spec. Gen. et Ord. Alg.*, ii., 278. Travers' Coll., 96, 97, 113.
16. *Ptilota formosissima*, Mont. *Voy. Pôle Lud.*, 97, t. 9, fig. 3. Travers' Coll., 104.
17. *Ballia Brunonia*, Harv., in Hook. *Journ. of Bot.*, ii., 191, tab. 9.; *Ballia callitricha*, Mont., in *d'Orbign. Dict. Univ.*, tab. 2. The specific name, chosen by Harvey, as the oldest, can only be adopted. Travers' Coll., 91.
18. *Caulerpa furcifolia*, J. Hook. and Harv., in *London Journ. of Bot.*, vi., 416. Travers' Coll., 93.

III.—CHEMISTRY.

Art. XXXVI.—*On the Absorption of Sulphur by Gold, and its Effects in Retarding Amalgamation.* By W. Skey, Analyst to the Geological Survey of New Zealand.

[*Read before the Wellington Philosophical Society, September* 17, 1870.]

A part of the duty assigned to me while recently on the Thames gold-field, was to investigate into the causes of the loss of gold experienced by the proprietors of the several batteries in that district, when working the auriferous material.

From an acquaintance with the various mechanical arrangements adopted there for securing the gold, and from a knowledge of the nature and amount of such loss, I was soon led to infer that much of it could scarcely be referred to any of the causes severally supposed to be operative.

The affinity of gold and its richer alloys for mercury is so great, and their negativeness, or unaffectibility, to and by the various chemical substances naturally having contact with them, so universally and so authoritatively affirmed, that it is generally supposed all we have to do in order to obtain an amalgam of gold and mercury, is to present them to each other, with their surfaces free from dust or stain, and to all appearance chemically clean.

But, in experimenting upon a few samples of the Thames gold, I found that though apparently quite free from any such stains, etc., they would not uniformly amalgamate over their entire surfaces; some, indeed, would not amalgamate in the least, though to all appearance as bright, as clean, and as chemically similar as those which did; the action of boiling water upon these did not in the least affect their negativeness to the mercury. This could not therefore be owing to the intervention of air mechanically adherent to them.

Observations taken since my return, show besides, that several of the cleanest-looking samples of the Otago gold which have been deposited in the Colonial Museum, manifest a similar negativeness to mercury—even to whole samples of fine alluvial gold, and those surfaces of small nuggets so situated that it was impossible they could have been hand-soiled.

All these specimens were rendered readily amalgamable by cold solutions of cyanide of potassium, nitric acid, chromic acid, or chloride of lime acidified, and, with the exception of the more cupreous of these, they were also rendered amalgamable by roasting them in an open fire for a few minutes.

Obviously, therefore, some foreign substance occupied these non-amalgamable surfaces, excluding the mercury from contact with the auriferous alloy, which substance was dissipated or decomposed by heat, and capable of removal by the several re-agents specified; the question then arose, What could this substance be? and I began to suspect that sulphur, in some form or other, was this substance, since its deportment under these conditions would certainly be very similar.

I therefore well cleaned the surfaces of several samples of Thames and Otago gold, and one of pure gold, and placed them for a few seconds in sulphuretted hydrogen gas, well washed them afterwards, and dipped them into clean mercury, when, in the place of being instantly whitened over their whole surfaces by the mercury, they absolutely refused to amalgamate with it upon any part, and even seemed to exercise a repulsive force upon it.*

The same effects, or rather *non-effects*, in relation to the mercury, followed when alkaline sulphides were substituted for the surphuretted hydrogen, also when the samples of gold were kept a short time in boiling water, in contact with sulphur—a platinum crucible being used as a precautionary measure against the introduction of alkaline matters. As in the case of the first series of specimens, these were rendered amalgamable by treatment with cyanide of potassium, nitric acid, chromic acid, or chloride of lime, also by the application of heat to the less cupreous ones. † The effects of heat on those samples containing 6 per cent. of copper (and perhaps much less) being to produce such a film of the oxide upon their surfaces that the mercury is still excluded from them, though from a different cause from that above mentioned. These samples also readily amalgamated with sodium amalgam.

Gold thus treated with sulphuretted hydrogen, sulphur, or alkaline sulphides, and thoroughly washed, then put in pure cyanide of potassium, gave a good reaction of sulphur to the nitro-prusside test; and I have also obtained, in the same manner, very distinct reactions of sulphur upon several of the native gold samples in the Museum.

These results clearly show that gold, even when in its purest state, is by no means so negative to sulphur and its compounds as is supposed, but that, on the other hand, it absorbs sulphur with great avidity; and they further show, that when this sulphur is thus absorbed by gold, even when only in very minute quantity, the metal refuses to amalgamate, although there is no visible change induced in its appearance.

Taken in connection with the presence of sulphur (or a compouud of it)

* This was illustrated at the close of the meeting.

† The chlorides of gold and mercury, also nitrate of silver, have been found lately to have the same effect. See paper "On the reduction of various metals from ther solutions by metallic sulphides, etc."

upon many samples of native gold, and the certainty that one or other of the sulphurizing agents specified does frequently occur naturally in metaliferous rocks, it seems highly probable that a large area of the natural surfaces of native gold is sulphurized, and thus rendered, according to the degree of this, non-amalgamable.

If this is so, a very sufficient cause appears for the heavy loss in the precious metal, experienced by the mill-owners in working their auriferous reefs by the amalgamation process, since it would only be those portions or grains thus sulphurized, which have chanced to get their surfaces abraded during their extraction or milling, that would be at all likely to adhere to the mercury used.

Whether this absorption is a purely mechanical one, as is assumed for that where platinum acts upon sulphurotted hydrogen and other gases, or whether it is a truly chemical one, is a matter of some interest to enquire into, particularly in connection with the, as yet, unsolved problem relative to the mode of solution and deposit of native gold; also, in relation to the question of absorption generally.

By what can properly be deduced from the facts above stated, and those which have manifested themselves to an investigation carried on especially to determine this point, it certainly appears that this absorption is the effect of chemical action.

Thus, if this absorption is mechanical, the sulphur must be in one of the two following conditions :—

I. As free sulphur.

II. Combined with hydrogen, as sulphuretted hydrogen.

I. That it is not as free sulphur was evidenced by the fact that boiling ether or bi-sulphide of carbon—two liquids having considerable affinities for sulphur—would not remove it from the gold; for, after long contact with these solvents and an after thorough washing, the gold still refused to amalgamate.

Neither of these liquids had any effect upon clean gold in regard to its behaviour with mercury.

II. That it is not combined with hydrogen, and thus condensed on the gold surface as sulphuretted hydrogen, appeared from the circumstance that sulphurous acid effected no apparent change on it; the action of this acid on sulphuretted hydrogen being a rapidly decomposing one, sulphur being liberated in a free state, capable of being detected and identified as in this state, which I could not accomplish.

Not appearing to be in either of these forms, therefore we must assume it to exist in chemical union with the metal as a sulphide of gold, forming a film of true auriferous pyrites, as was first suggested to me by Dr. Hector.

Independent of the proof derived from experiment, it may be expected that sulphur brought into close contact with a metal which we know does

form chemical union with it in a wet way, and at common temperatures, would then be in an extremely favourable condition for the exercise of chemical affinities; and the same argument applies for absorption being generally chemical, wherever there are affinities existing at the temperatures we employ between the absorbants and the absorbed substances.

Indeed, so far as these experiments and these arguments are deemed conclusive in favour of the absorption of sulphur by gold being chemical, by so much are we compelled to diverge from the received opinion that the absorption of the common gases by platinum is always a mechanical one, and are compelled to distinguish varieties of absorption.

The affinities of sulphur, also oxygen, for platinum, are superior to their affinity for gold, why not therefore suppose sub-sulphides, or sub-oxides, to form, when these substances are respectively absorbed; but the whole question of these minute actions of metallic surfaces requires rigorous investigation, and for this I doubt not the mercury test here used for proving absolute cleanliness of surface will often prove very useful.

Reverting to that which more strictly falls within the scope of this paper, as sulphur has been found upon native gold, I should be quite prepared to find the metals tellurium and selenium also upon the natural surfaces of the gold of Transylvania and the Thames (these substances being isomorphous with sulphur and more fixed), as telluric gold is found in Transylvania, and the character of the two golds assimilates.

In conclusion, I would beg to observe the necessity of fully establishing the character of this absorption of sulphur by gold. If it is a chemical act, as present evidence tends to show, and sulphides of gold and platinum are so easily and so rapidly formed, we cannot doubt but that sulphur plays a very important part in the solution and translation of these metals from rock masses to intersecting quartz reefs, or from deep strata to superficial positions.

In whatever form, however, sulphur is thus absorbed by gold, it is certainly the greatest obstacle to a thorough and complete amalgamation which we have to contend with; no doubt other substances occasionally intervene to prevent or retard this process, such for instance as the oxides of iron and organic matter, but sulphur and its isomorphs must, I think, be the most actively and the most frequently concerned in this refusal of natural gold surfaces to amalgamate. In case further investigation should prove this sulphurization of the natural surfaces of gold to be general, it will be easy to look for a remedy against its effects; but, as yet, it would be useless to speculate as to what this should be. As stated, there are several ways of removing these films: perhaps chloride of lime in conjunction with muriatic acid would prove serviceable, but, unfortunately, it could only be applied to the "stuff" before amalgamation, and there might be a loss of gold occasioned by solution.

The sodium amalgam of Crooke would be a safe and certain remedy, and

easily applied; its effect would be in relation to this sulphide, to decompose it, and so expose the encrusted gold to the action of the mercury.

Doubtless the great benefit which has often attended the use of this amalgam has been principally due to the exercise of this kind of action.*

ART. XXXVII.—*On the Production of a Mono-hydrate of Chloride of Barium.* By W. SKEY, Analyst to the Geological Survey of New Zealand; *with Notes on its Crystallization*, by E. H. DAVIS.

(With Illustrations.)

[*Read before the Wellington Philosophical Society, September* 17, 1870.]

IN testing a mineral from the Thames gold-field containing baryta, I observed that the chloride of this base deposited crystals from its hydrochloric acid solution, differing considerably in shape from those described as belonging to the common bi-hydrate; they also differ in lustre, which inclined to pearly. I therefore analyzed these crystals, and the results of this give the following formula: Ba Cl + HO. This is then a mono-hydrate of chloride of barium, which is the lowest hydrate yet obtained.

Like the bi-hydrate, it effloresces in the air at common temperatures.

The action of hydrochloric acid in determining the production of this variety, is no doubt referable to its affinity for water, this being superior to that of the monohydrated salt.

This salt has been microscopically examined by Mr. Davis, and the accompanying drawings of the crystals, and notes thereon, have been furnished by him.

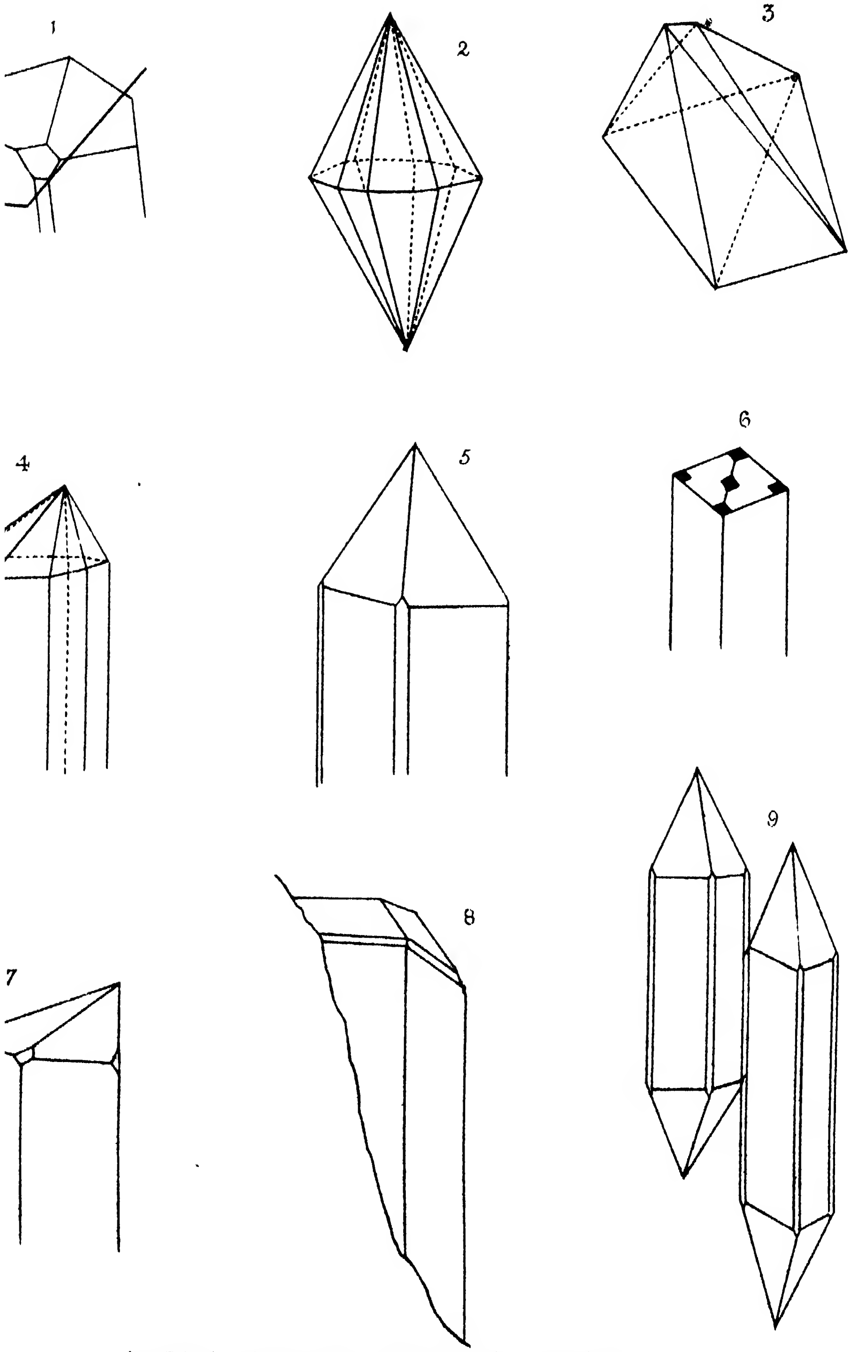
On the Crystallization of Ba Cl HO.

The crystals are white and pearly, and effloresce rapidly; they are exceedingly small, requiring a high magnifying power to make them at all distinct. The system is tetragonal, the same as the bi-hydrate of barium, but, unlike that compound, all the crystals are ditetragonal forms, or at least have a combination of the ditetragonal and first kind of tetragonal, or of the first and second kinds. The relations of the parameters could not be determined for certain, for want of a proper instrument.

Pl. XXVI., fig. 1, is a ditetragonal pyramid, very perfect, having the parameters as 1 : 1 : 2 as nearly as possible.

Fig. 2, is a ditetragonal spheroid or scalenohedron, its parameters are nearly 1 : 1 : 2·5.

* For further discussion of this subject, see *N. Z. Geol. Survey Reports*, 1870, p. 70.



1. NEW CRYSTALLINE FORM OF IRON PYRITES.
2 to 9. CRYSTALS OF MONOHYDRATED CHLORIDE OF BARIUM.

del. J.B. lith. Printed at the Gen. Gov. Lith. Press,

Fig. 3, is a ditetragonal prism, broken at one end, and terminated at the other by an obtuse pyramid.

Fig. 4, is similar to Fig. 3.

Fig. 5, is a combination of a primary prism with a prism of the second kind, apex being the pyramid of the first kind.

Fig. 6, is interesting, as it presents the curious marking hitherto (I believe) peculiar to chiastolite, which is a rhombic crystal.

Fig. 7, is a normal prism terminated by a pyramid, having its angles replaced by a more acute pyramid of the second kind.

Fig. 8, is a combination of a primary prism having an acute pyramid capped by one more obtuse, which is again terminated by a pinacoid; this crystal is either one which has lost its water of crystallization, or, what is more probable, it has absorbed one equivalent from its neighbour, which was quite opaque to polarized light.

Fig. 9, represents two crystals, both perfect, consisting of combinations of primary and secondary prisms and pyramids.

All these were carefully examined and drawn while under the microscope; they present no features by which they could be certainly recognized from some other salts, but as a new compound, it is interesting to observe the complete change in the style of the crystallization which one equivalent of water can cause.

Art. XXXVIII.—*Researches on the Absorptive Properties of Platinum.*

By W. Skey, Analyst to the Geological Survey of New Zealand.

[*Read before the Wellington Philosophical Society, October 22, 1870.*]

The researches embodied in this paper were collateral with those given in Art. XXXVII. in point of time, and of a kindred nature, but I preferred to state the results of them separately, as the subject itself is foreign to gold mining interests, to which the other appears intimately connected.

Shortly stated, these results are as follows:—

When a piece of freshly-cleaned platinum is placed in the vapour of sulphuretted hydrogen, or in solution of sulphide of ammonium, at common temperature for a few minutes, then well washed in distilled water, it will be found to have acquired such a condition upon its surfaces that metallic contact cannot be established between it and mercury; whereas, before treatment with these sulphur compounds, amalgamation rapidly proceeded over the whole surface of such piece on the application of mercury.

When the sulphuretted hydrogen was thoroughly dessicated, before administration to the platinum, amalgamation was neither prevented nor retarded; at least, I could not observe any such effect.

Platinum rendered thus non-amalgamable, becomes again readily amalgamable at a temperature of 400° to 600° F., also by a short contact with any of the following substances at common temperatures,—chromic acid, nitric acid, nascent hydrogen, or chlorine.

Sulphuric and hydrochloric acids had not this effect, neither had cyanide of potassium, not even when boiled with it.

Upon the surfaces of platinum thus treated with either of these sulphides, sulphur was readily detected by digesting them in a boiling solution of cyanide of potassium, and applying the nitro-prusside test.

It further appeared that platinum is also brought into a non-amalgamable condition by a short contact with either aqueous solution of potash or ammonia; even distilled water had the same effect if allowed contact for an hour or two; this may be owing, however, to traces of ammonia present in it.

In these cases, however, the application of hydrochloric or sulphuric acid to the platinum, rendered it readily amalgamable.

Clean platinum has been found to amalgamate readily, after twenty-four hours contact, with dry air.

In none of these cases did the metal appear to sustain any visible change upon its surfaces.

The results thus stated, tend to show,—

1st. That platinum, like gold, is capable of absorbing sulphur at common temperature, from either a solid or gaseous compound of it.

2nd. That this absorption is chemical.

3rd. That this metal is superficially oxydized in alkaline solutions.

These results, therefore, to a certain extent appear to impugn the correctness of the opinion that gaseous absorption by platinum is, in every case, simply mechanical.

Art. XXXIX.—*On the Capability of Certain Sulphides to form the Negative Pole of a Galvanic Circuit or Battery.* By W. Skey, Analyst to the Geological Survey of New Zealand.

[*Read before the Wellington Philosophical Society, October* 22, 1870.]

When a piece of massive galena is placed in voltaic contact with amalgamated zinc, and immersed along with it in weak sulphuric acid, to within an inch or two of the point of contact, a galvanic current is at once established, gas in quantity being given off at the surfaces of the galena, while the zinc is rapidly oxydized.

Three or four such pairs when connected among themselves, intensity fashion, afford a current of electricity strong enough to decompose acidulated water, and manifest all the phenomena of a small galvanic battery. Such an

arrangement may properly be termed a *pyritous battery*—in accordance with the custom hitherto observed, of designating new forms of batteries after some distinguishing or novel feature in them.

Several other metallic sulphides manifest similar phenomena when coupled in this manner with zinc, amongst which are the following :—zinc blende, copper pyrites, vitreous copper stibnite, proto-sulphide of iron, and the sulphides of silver, mercury, platinum, and gold.

The only sulphide I have yet found any difficulty with in setting up this action, under these conditions with zinc, is mundic, or the bi-sulphide of iron; but if the point of contact between it and the zinc is submerged in the acid, gas is evolved at this point, and the area of evolution rapidly spreads around from this, until the whole surface of the specimen becomes active.

The gas given off from the surfaces of these sulphides in the foregoing experiments, was *sulphuretted hydrogen.* The effects, therefore, upon these sulphides when thus made to form the negative pole of a galvanic pair, is to desulphurize them; in some cases the ultimate effect is to reduce the metal to the metallic state. At any rate this obtains for the sulphides of mercury, lead, silver, platinum, and gold. With common yellow copper pyrites, a beautiful iridescence is communicated to it in a few seconds after the liberation of gas commences, owing, of course, to desulphurization.

Saline solutions appear to produce the same effects in these instances as sulphuric acid, but they take place much slower.

The fact is thus directly established, that several of the metallic sulphides are capable of performing all the functions of the negative pole of a galvanic pair. From this, and the manner in which these sulphides have been connected with each other, it is clearly demonstrated that they are pretty good conductors of electricity. To a certain extent, indeed, all bodies are conductors of electricity, the terms conductor and non-conductor being only expressive, as Faraday affirms, "of extreme degrees of one common condition," there being no complete conductor, nor any absolute non-conductor; but these results show, I think, these sulphides are conductors to a degree not before recognized —a circumstance which renders a comparison of their conducting power with that of other conductors necessary.

Indirectly it has appeared, that nascent hydrogen is able to decompose these sulphides at common temperatures, by combining directly with their sulphur, thus accomplishing at a low temperature that which would require a very high one, in case it (the hydrogen) were presented to the sulphide in its ordinary form.

In relation to the amalgamating processes used for the extraction of gold at our batteries, these results prove that zinc amalgam, in contact with acid solution, has precisely the same effect in decomposing the sulphides of gold, mercury, iron, etc., as sodium amalgam; like this amalgam, therefore, it keeps

perfectly bright and mobile in presence of sulphides, or the products of their natural metamorphoses.

Whether or no such an amalgam could ever be profitably substituted for sodium amalgam in our gold batteries, has yet to be determined. I am afraid that the continual addition of sulphuric acid to the water conveying the auriferous stuff to the plates, etc., which the use of this amalgam necessitates, would increase so much the cost of extraction as to render it unprofitable; still, as the water need only be very slightly acidified, it may be well to keep the fact thus arrived at in mind, when projecting intended improvements in the amalgamation of the gold from auriferous reefs.

In conclusion, I will only now remark, that the kind of phenomena just described appear to have some relation to the formation and decomposition of metalliferous lodes.

It is pretty certain, analogically considered,* that these sulphides should be able to form among themselves a series of voltaic pairs in presence of saline solutions, as they differ from each other in respect to their affinities for oxygen. Galena and copper pyrites, for instance, should form a voltaic pair, in which the galena would be the negative element; sulphide of silver and galena again should furnish another pair, in which the galena would have its function reversed, and so on for the rest, according to their relative proneness to change.

In a natural way, therefore, the contact of dissimilar sulphides generally should set up galvanic action and chemical decomposition, and by setting up this action, we might have a sulphide decomposed by saline solutions, which it would be able to resist if it stood alone; or, on the other hand, we might have an easily decomposable sulphide preserved by the association with it of one still more ready to decompose.

Since the results just detailed were arrived at, I have been referred by Dr. Hector to a paper by Mr. Robert Hunt, entitled, "Researches on the Influence of Magnetism and Voltaic Electricity on Crystallization and Conditions of Matter," given in *Memoirs of Geological Survey of Great Britain*, Vol. 1.

The subject of that paper is similar in part to this under consideration, but I do not see that the author has anticipated any portion of the results stated here; he certainly does not demonstrate the actual and continuous production of electricity by the contact of sulphides with positive bodies in saline solutions; nor does he show that copper pyrites conducts electricity, the water-line being, as you will observe by reference to his diagram 14, page 457, above the point of contact between the pyrites and the battery, so that the change or decomposition of the ore need not involve the necessity of conducting power in the pyrites, as in the case of that connected with the positive end of the

---

* Since determined to be the case.—See Art. XLI.

battery, the conducting power necessary for this decomposition might well have progressed around, from this point or line of contact by the liberation of copper; while, in case of the other piece of pyrites, all the conducting power necessary for the production of the phenomena described may, with propriety, be referred to the wire bound around it.

I would also state, that in repeating this experiment of Mr. Hunt's I find that, different to his own observations as stated, both the pieces of pyrites are chemically affected, while it is not that in contact with the copper of the battery which displays such marked iridescence, but that communicating with the zinc; and it passes into this state not by an oxydation process, but by a desulphurizing one, brought about by the liberation of hydrogen upon its surfaces; this gas, when freshly liberated, having a desulphurizing effect upon sulphides generally, as I have clearly shown above.

Art. XL. — *On the Reduction of Certain Metals from their Solutions by Metallic Sulphides, and the relation of this to the occurrence of such Metals in a Native State.* By W. Skey, Analyst to the Geological Survey of New Zealand.

[*Read before the Wellington Philosophical Society, November* 12, 1870.]

In a paper read by Mr. C. Wilkinson before the Royal Society of Victoria, "Upon the Formation of Gold Nuggets," publicity is given to the fact, first observed by Mr. Daintree, that gold when placed in a solution of its chloride, undergoing decomposition by contact with organic matter, determines the deposit of much, or all, the liberated gold upon itself.

In the same pages, the author states that he finds copper, iron and arsenical pyrites, galena, zinc blende, stibnite, wolfram, and molybdenite, also act as nuclei for gold thus reduced; but that brown iron ore and quartz do not.

The general correctness of these statements has been verified by the results of a critical enquiry, conducted by Mr. Cosmo Newberry, Analyst to the Geological Survey of Victoria; but I notice that there has not been any attempt on the part of either of these authors to explain these very singular phenomena.

That gold itself should be nuclear to gold slowly precipitating from its solution, is by no means abnormal or unrelated to other phenomena; it is, in fact, just what we should expect from a consideration of the mode of deposit of numerous other substances from their solutions, whether such deposits are crystalline or amorphous, they generally tend to arrange themselves round a nucleus of their own substance; but that substances so chemically dissimilar as those specified by Mr. Wilkinson, both as compared among themselves and to gold, should also be nuclear under these circumstances, appeared altogether so

strange and anomalous, that I was induced to make further researches into this subject, for the purpose of ascertaining what other substances (if any) could be added to this list of nuclei rendered, and whether any of them could be nuclear for other metals during their slow precipitation, so that from an enquiry thus extended some general principle might be discovered regulating and explaining such deposits.

The results of these I now beg to lay before the Society; they have been so singular and unexpected, and have taken a direction so different to that contemplated for them, that I have had to change the title of this paper as first adopted and worked to, to the one now assigned to it.

I found, in the first place, on repeating the experiments adverted to, with certain modifications, that in the case of wolfram, the tendency of gold to deposit thereon might properly be referred to the well known reducing power of the soluble proto-salts of iron upon salts of gold, since proto-oxide of iron forms a considerable portion of this mineral, and is actually dissolved away from it, to a small extent, by dilute acids at common temperatures; at least, I found it so in the case of a specimen of wolfram I had from the Museum.

The case, therefore, so far as these results of Mr. Wilkinson's are concerned, is reduced to one in which there only remains to consider the metallic sulphides and arsenides—a set of minerals both chemically and mineralogically related to each other.

Now, in respect to these sulphides, it is distinctly stated in Mr. Newberry's paper, that in even weak solutions of terchloride of gold (the salt used in his experiments), they decompose but so slowly as not to "interfere with the deposit taking place regularly;" having corroborated the correctness of this statement, and also proved that the arsenides are similarly affected, it occurred to me that, though hitherto quite unexpected, this decomposition was very intimately connected with the first deposit of gold upon these sulphides; that in reality the commencement of metallic deposit was effected, not by the interaction of organic matter as supposed, but by that of the several nuclei themselves with the salt of gold.

I therefore agitated a little finely-powdered galena (sulphide of lead) with a weak solution of terchloride of gold, omitting the addition of organic matter, and taking every precaution against its presence accidentally, when I found, after a little while, the gold solution had become quite colourless, and on testing it, not a trace of this metal could be found; it had evidently been absorbed as it were by the galena, and, in fact, a careful inspection of the mineral showed it to be feebly gilded.

Small cubes of galena simply immersed for a few hours in strong solution of the gold salt, without organic matter, were so thoroughly gilded over the greater part of their surfaces, that in certain positions they could not be distinguished by the eye from gold.

Chloride of gold was also found to be reduced by contact with the following sulphides,—they include, as will be observed, all those mentioned by Mr. Wilkinson—sulphides of iron (proto and bi-sulphide), sulphides of copper (ferro-sulphide and sub-sulphide), and the sulphides of zinc, tin, molybdenum, lead, mercury, silver, antimony, bismuth, arsenic, platinum, and gold; and among the arsenides, mispickel and arsenide of silver; cubical iron pyrites is rather slow in its action upon this solution of gold, while sulphide of antimony scarcely affects it at all at first, but after some hours contact with it, reduction goes on rapidly, perhaps by aid of some voltaic action. All these effects were produced at common temperatures (with the exception of that with sulphide of bismuth), while other experiments with iron and copper pyrites prove that similar effects are produced when all kind of light is excluded, so there is no reason to suppose that light has been concerned in any of these re-actions.

I should state that in the case of some of the highly-coloured minerals, such as cinnibar and arsenide of silver for instance, it is necessary to operate upon their *streak* in order to obtain a visible deposit on them, at common temperatures within a reasonable time, with hot solutions; however, even these are well gilded in an hour or two.

A portion of the metal of the sulphide operated upon was uniformly found in the solution afterwards, and also sulphuric acid; the mode therefore in which these effects were produced, was evidently by the oxydation of both the constituents of the nucleus employed, at the expense of the chloride, or rather the hydrochlorate of oxide of gold—supposing, as seems probable, an equivalent of water combined with it as administered.

Thus we have removed this singular anomaly of gold in the act of precipitating, selecting as nuclei substances so diverse from it, while refusing others which differ no more from such non-metallic nuclei than do these from gold; as it certainly appears from these results that whatever gold has been reduced by organic matter in the experiments quoted, would never deposit on these non-metallic nuclei, surface to surface, but only upon gold already occupying such surfaces, reduced by the exercise of affinities far superior and swifter in their action than those involved in the decay of wood or other organic structures, used by Mr. Wilkinson in the experiments alluded to.

The question next arose, if organic matter is unnecessary, as it certainly is for the commencement of gold deposits on these nuclei, is it necessary for their continuance, and to give them that close coherent form obtained when such matters were administered? experiment proved it to be unnecessary as it was found that the solution after depositing a certain time gave films towards the angles of the nuclei, which were of some thickness, and which, under the microscope, appeared quite continuous.

The non-necessity of the addition of organic matter to ensure the deposition of gold in these experiments by Mr. Wilkinson, being thus shown, and the

reducing action of metallic sulphides and arsenides upon salts of gold manifested, it became of some interest to ascertain whether or not any other metallic salts were capable of being reduced by these, or any of these substances.

This part of the subject I have only slightly investigated, but enough has been discovered to show that silver and one or more of the metals of the platinum series, are reduced from their soluble salts by these substances generally.

Thus, silver is reduced from either its nitrate or acetate very readily by galena, copper pyrites, and the inferior sulphides of iron and copper; from ammoniacal solutions, however, it does not precipitate on any of these sulphides, not even when heated with them, except upon sub-sulphide of copper; as reduced by galena, it selects some angular part of it to deposit on, and sometimes strikes off from this in beautiful arborescent forms, and minutely crystalline filaments, exactly like those which the metal generally assumes in its native state.

Cubic iron pyrites, also stibnite, has little or no effect upon silver salts, not even when heated with them; arsenide of silver has, however, a feeble effect.

The metal platinum is very slowly removed from its bichloride solution by galena and grey copper ore; also by iron pyrites, but still more slowly. These were the only sulphides tried.

Mercury does not appear to be reduced to the metallic state by any of the sulphides enumerated, from its bichloride solution, but most of them reduce it to the sub-chloride,—sulphide of gold even, thus affects this mercurial salt, the sulphur being oxydized and the gold set free.

Neither the sulphate nor the acetate of copper are affected by these sulphides, but per-chloride of iron is reduced to the proto-chloride by galena and grey copper ore.

Before I proceed to the next part of the subject, I will state here the results I obtained when other gold solutions were administered to these sulphides; the one hitherto employed in the experiments described being, as will be remembered, a chloride.

When, in the place of this salt, I applied the oxide of gold in solution of either potash, bicarbonate of soda, or silicate of potash, the effects were always the same; at least they were so with galena, sulphide of copper, or proto-sulphide of iron.

Ammoniacal solutions of gold, however, required their temperature raised to 200° F., in order to give a decided gold deposit on these sulphides; while in the case of the *sulphide* of gold, dissolved in either bicarbonate or soda, silicate of potash or ammonia, no reduction of the metal occurred by contact with any of the sulphides enumerated, either at common temperatures or at that of the boiling point of these several solutions; nor yet was any

reduction effected by the addition of other strong deoxydizing agents, such as tannic or gallic acid, to these various solutions of the auriferous sulphide.

All this tends to show, I think, that in the instance where Mr. Newberry obtained the reduction of gold upon iron pyrites, from the solution of its sulphide in bicarbonate of soda mixed with organic matter, the gold had, prior to the act of reduction, become in some manner divested of its sulphur, and in exchange for this had combined with oxygen, thus passing to an oxy-salt, readily reducible by deoxydizing agents.

During the period of time which had to be allowed by Mr. Newberry for this experiment, the oxygen of the air might perhaps have oxydized the sulphur of the auriferous sulphide, as it does that of several other sulphides, and so reduced the gold amenable to the deoxydizing power of such substances as the metallic sulphides; any way, it is inconceivable how organic matter and metallic sulphides, singly or conjointly, can desulphurize such a sulphide as this. The effects of organic matter in a state of decay is rather to generate sulphides than to decompose them, thus retarding, in the place of promoting, the reduction of gold from such compounds.

It is hard to suppose that there could have been any chemical interchange effected by the mere addition of bicarbonate of soda to the gold sulphide,—gold having far more affinity for sulphur than for oxygen, it could hardly pass to an oxy-salt therefore in this manner; besides, if it could, then reduction should have proceeded as well with this kind of solution as with the gold *oxide* in solution of bicarbonate of soda, which, as stated above, I found was not the case.

Further experiments in this direction are however absolutely necessitated, from the importance of ascertaining positively, whether there is any solution of gold (likely to occur naturally), able to resist the reducing effects of either metallic sulphides or organic matter, at common temperatures.

The several results arrived at in these investigations are now stated; it only remains therefore to point out, or rather to refer to, the very obvious relations they appear to sustain to the manner in which certain of our native metals are frequently associated.

The great deoxydizing power of sulphides generally upon most gold, silver, or platina salts, as manifested by the experiments just described, renders them so absorbent as it were of these metals, when presented to them as chlorides or oxy-salts (the forms usually contemplated for them when in solution), that any such solutions traversing even a very thin vein or reef of the common metallic sulphides, would in all probability be completely divested of these metals.

Solutions of silver however would be little, if anything, affected in traversing a reef of common iron pyrites or stibnite, alone, but if the solution contained gold in addition, it would be very probable that a certain portion of the silver

would precipitate along with the gold by a simple chemical substitution. On the other hand, silver would readily be absorbed by inferior sulphides, and also by galena.

All this agrees very well with what we find on examination of these sulphides; indeed, the facts thus stated seem to explain at once the reason of the almost constant association of gold and silver with certain of our metallic sulphides, and their absence or comparative scarcity in others.

Whether such is the true explanation of this or not, the knowledge that metallic sulphides and arsenides are capable of reducing several metals from their solutions, should, I think, be taken into consideration when we attempt to explain the origin of these metals in the forms they have taken, and in the rocks or veins they have selected.

As yet, most of the theories broached for the explanation of the occurrence of such deposits in these matrices, are based upon the reducing power of organic matter; when the fact is, that most or all of these sulphides are much superior in this respect to such matters, being far more rapid in their effects, and capable of reducing, weight for weight, more metal; a single grain of iron pyrites being sufficient to reduce $8\frac{1}{8}$ grains of gold.

Besides, organic matter could scarcely exist in such quantity among our older and more altered rocks, or be carried there in such quantity as to effect the reduction of gold in such quantity and in such confined spaces as it is occasionally discovered in.

While therefore allowing that organic matter may have had a share in the reduction of this and other metals, I cannot but think that by far the greater portion of these deposits—especially those deeper seated ones at a distance from carboniferous strata—have been due to the deoxydizing effects of pyritous minerals.

Of course both theories require, as a common ground, that the metal was first in the form of a salt, soluble in water—a condition which is generally conceded, and which I have therefore all along taken as actually obtaining.

I cannot take leave of this subject without adverting to, and commenting upon, some of the singular chemical reactions which these researches have opened up.

In the first place we learn that aqueous solutions of the oxy-salts of gold—among which I include the chlorides, for reasons above stated—possess oxydizing power to an extent not hitherto contemplated for them, great as this may have been acknowledged. I think it is a little superior to that of chromic acid—one of the most powerful oxydizing agents we have—since it attacks cubical pyrites pretty readily in the cold, while chromic acid scarcely affects it.

Further, these gold salts not only oxydize the metal of these sulphides, but their sulphur too; though I find from actual experiment that common sulphur (crystallized), or recently precipitated sulphur, does not appear to be the least

affected by such solutions, not even when these are applied at the temperature of their boiling points.

This vulnerability of combined sulphur as against the invulnerability of free sulphur, suggests that the former may in the first place have been set free by the oxydation of the metallic portion, and being set free in a nascent form, it might, by virtue of this, combine with oxygen as hydrogen, when in the same state it combines with it, as shown in a former paper of mine.

At the same time, it appears that sulphur can be oxydized by these salts, while it is in combination,—as in the case of the auriferous sulphide for instance,—the metallic portion, of course, remaining throughout unattacked, and so ultimately becoming quite reduced.

Chromic acid, and cold nitric acid too, I may mention incidentally, affect this sulphide, as also the others, exactly as chloride of gold does, though neither of them appear to have any action on native or precipitated sulphur at common temperatures.

The oxydation of sulphur in these cases it is more difficult to give a reasonable explanation for, but probably as combined with the metals, it takes quite a different form and characters to any of those yet known to be possessed by it while in a free state.

In conclusion, I would ask leave to observe in relation to these oxydizing effects of gold solutions upon metallic sulphides, the rather singular circumstance that in full cognizance of the great oxydizing power of such solutions, and also that of the proneness to oxydize exhibited by certain metallic sulphides, the fact of the general association of gold with such sulphides did not before suggest, rightly or wrongly, that such association had been due to some mutual chemical interaction, obtaining between soluble auriferous salts and those metallic sulphides in which gold occurs.

This omission to apply the knowledge of such well known facts to the explanation of the singular association of gold with these minerals—a problem which has engaged so much attention—is encouraging in the extreme to those who, like us, are cut off by our geographical position from the use of those refinements of scientific research, and the inspiring contact with those great master-minds enjoyed by others occupying more favourable positions; since it shows, that notwithstanding the great progress which has been made, and is daily making, in scientific knowledge generally, the easier and more simple applications of known facts to the interpretation of phenomena hitherto unexplained, are not yet exhausted; and it shows besides that there is still, for those who wish it, work to do, and work which requires for its successful prosecution only the simplest appliances, and very ordinary investigating power.

ART. XLI.—*On the Electro-motive Power of Metallic Sulphides.* By W. SKEY, Analyst to the Geological Survey of New Zealand.

[*Read before the Wellington Philosophical Society, November* 12, 1870.]

IN a paper read before the Society at its last meeting, I showed that the metallic sulphides generally were such ready conductors of electricity that they could perform all the functions of the negative pole of a galvanic battery; and I stated that, reasoning from analogy, it appeared these sulphides should among themselves, in presence of saline solutions, form voltaic pairs having a decomposing effect upon certain metallic salts.

In continuation of the subject, I have been investigating into this, and the results clearly showing such to be the case, I beg to communicate the fact, together with various particulars concerning it.

I will preface my statement by observing, that it is well known the mere contact of heterogeneous solids of whatever kind, even to gypsum and amber, as Pfaff observed, develop electricity, but of such feeble tension that very delicate electroscopes are required for its detection; and just recently, Professor Becquerel has proved the same feeble development of electricity occurs when gold is placed in saline solutions having no affinity for it.*

The object, therefore, of this communication is not to demonstrate for these sulphides the possession of a property hitherto unknown, but that they are able to manifest this particular property to such an extent in those saline solutions frequently having contact with them in a natural way, that they are able by such development to produce several chemical reactions, and among them to reduce certain metals from their soluble salts,—the possibility of which should certainly be considered when we enquire into the production and metamorphosis of mineral veins and their metallic contents.

Thus, when common iron pyrites and galena are placed in dilute acids or saline solutions, within a short distance of each other, and connected by platinum wires, with a solution of gold chloride contained in a separate vessel, it will be found, after the expiration of a few hours, that the wire connected with the galena has been well gilded over that end of it submerged in the gold solution.

Clearly therefore a voltaic action has been set up by these sulphides here, the galena has substituted the zinc, or positive element, of our ordinary battery arrangements, while the iron pyrites has substituted the negative one.

Galena and sub-sulphide of copper form another voltaic pair, in which the galena is this time the negative element.

Besides gold, these sulphides are also capable of reducing silver and platinum from their acid solutions, but not copper, unless the positive electrode

* *Chemical News*, July 8, 1870, p. 21.

is of some metal having an affinity for the acid of the solution, so that in the case of this metal it is not so much a decomposition as a transference which takes place.*

With a zinc and platinum pair even, in sulphuric acid, it is only possible to reduce copper by this kind of transference, at least with common temperatures; so that this inability of metallic sulphides to reduce copper under these circumstances, is no indication of their inferiority to zinc in respect to the intensity of their electro-motive power.

In these experiments the wires were connected with the minerals well above the water line, and the surface of the latter kept dry to this line, so that the effects described were unmistakably due to the sulphides themselves acting upon the liquid around them.

Other sulphides manifest the same behaviour when dissimilar ones are paired in this manner.

The annexed column represents those which have been tested up to this date, stated in the order of their positiveness relative to each other in sea water. Any two of these, connected as I have described, will be found to be positive and negative respectively; and that occupying relatively the highest position in this column will always prove to be the positive one.

* The electro-deposition of copper upon a platinum plate, by means of a sulphide pair in sea-water (copper being the positive electrode for reasons above given), was exhibited at the close of the meeting, when, in the discussion which arose upon it, Mr. Hamilton, a member of the Society present, urged that the electrolytic effects produced were not due to the sulphides, but rather to the copper and platina used; these plates with the associated solution of copper sulphate being maintained by Mr. H. with great persistency, and against much remonstrance on my part, to form in this case "both the battery and decomposition cell, the sulphides employed merely completing the interpolar connection between these copper and platina plates."

This opinion being publicly expressed, and adhered to, I feel obliged to notice it, as it challenges the correctness of all which this paper was designed to convey and support, and thus has the effect, or at all events the *tendency*, to lead the Society to suppose I am in the habit of preparing papers for it, constructed so carelessly, and founded upon errors so gross and palpable, that anyone thinking and speaking at random may disprove them. All I need say in self-defence is, that I do not know of anything in the science of electricity which at all warrants such a view as that expressed by Mr. Hamilton being entertained; but for his satisfaction, I have repeated my experiments, and with such modifications that rendered it, if possible, a still more crucial test of the correctness of my statements—the results, it is needless to say, were quite at variance with those Mr. H. indicated. Thus, if we place a piece of copper, and one of platinum, in solution of sulphate of copper, and connect them *directly* with each other, we find that the platinum will *not* become coated with copper. If, then, no electrotypic effect is produced when the connection between the plates is metallic, it will be obvious that such effects would not be produced were (as in my demonstration) the electric resistance increased by the interposition of sulphides, and a thickness of salt water in the circuit, both being inferior conductors as compared to copper or platinum.

METALLIC SULPHIDES.

Proto-sulphide of iron.
Proto-sulphide of manganese.
Proto-sulphide of zinc. (Zinc blende.)
Proto-sulphide of cadmium.
Proto-sulphide of tin.
Proto-sulphide of mercury. (Cinnabar.)
Proto-sulphide of silver.
Proto-sulphide of lead. (Galena.)
Sub-sulphide of copper.
Sulphide of copper and iron. (Copper pyrites.)
Bi-sulphide of iron. (Iron pyrites.)
Sulphide of antimony. (Stibnite.)
Sulphide of gold.
Sulphide of platinum.
Sulpho-arsenide of iron. (Mispickel.)
Carbon, as graphite, sulphurized.

Compared with some of the metals, it was ascertained that in the same kind of solution zinc is positive to proto-sulphide of iron, while silver places itself between sulphide of silver and galena, and platinum between sulphide of platina and mispickel; graphite (freshly ignited) being negative to the whole of this series.

In weak sulphuric acid, the electro-motive order of these sulphides appears the same as in saline solutions, at least this was shown to be the case for the following:—proto-sulphide of iron, sub-sulphide of copper, zinc blende, galena, copper pyrites, and cubic iron pyrites. The greater number of these sulphides were natural productions.

Magnetite was found to be negative to galena, but positive to mispickel in saline solutions; hematite is generally negative to these sulphides, but its very inferior conducting power renders it difficult to obtain results with it.

Some of these minerals are so weakly positive to the one immediately below them, that slight admixtures with them of other sulphides might, very likely, change their positions in this column. Sulphide of antimony and mispickel, for instance, form a very weak voltaic pair, in which were a minute quantity of another sulphide to enter on either side, their position as here tabulated might be reversed.

A curious fact is expressed in this column, viz., that galena is more easily affected by these decomposing agents than copper pyrites; this being the opposite of what I should have supposed, as galena appears unalterable in ordinary circumstances, while the copper pyrites very soon discolours.

Compared to magnetite or hematite, the sulphides generally are far superior conductors of electricity.

The best conductor among the natural sulphides appeared to be mispickel, which vies in this respect with some of the metals.

As to the intensity of the electro-motive or electrolytic power which some of these sulphides are capable of developing, in contact with the exciting solutions instanced, I should think it to be little, if anything, inferior to that of zinc in like solutions; and, while this development would be slower, the absolute quantity of electricity producible should be much greater, weight for weight, as compared with that yielded by zinc, under similar conditions, if, as appears very probable, the oxydation of their sulphur also developes electricity. If such development is in proportion to the quantity of oxygen requisite to oxydize the sulphur to sulphuric acid, the electro-motive power of common iron pyrites as compared to that of zinc quantitatively would be about as four to one, since pyrites requires its own weight of oxygen to oxydize both its constituents to oxides permanent under ordinary conditions, while zinc barely uses one quarter of its weight for the same purpose.

Whether or not, however, the sulphur of these various sulphides participates to any extent in the production of the electrotypic deposit referred to, the knowledge that such kind of metallic depositions are possible in a natural way, is exceedingly suggestive in regard to the manner in which some metals have assumed the metallic form.

These results, taken in connection with the abundance of metallic sulphides in many of our mineral veins and rocks, make it appear very probable that much of our native gold, silver, and platinum, have been electro-deposited from saline solutions by voltaic action set up by the contact of dissimilar sulphides, or sulphides with more negative substances, such as hematite, magnetite, or ferruginous rocks.

Besides the bearing these results would seem to have in relation to the manner in which metals have been deposited, they tend, I think, to throw a light upon the mode in which those currents of electricity are produced and kept up in the crust of the earth, traces of which were discovered by Mr. Fox, about forty years ago, and afterwards by others, including Professor Reich, in verification of the correctness of Mr. Fox's assertions.

This discovery of Mr. Fox's, has such an intimate connection with the subject of this paper, that it is a matter of regret that I cannot refer to the particular volume of the *Transactions of the Royal Society* in which it was announced; but from what I gather from the works of those authors who have quoted from this paper, the most important points established by Mr. Fox were,—that these currents varied in intensity, also in direction, running east to west and west to east, and when stations at different depths were connected, the current was *generally downward;* the whole of his experiments being, I think, carried on in mineral veins.

It will be immediately seen how well this agrees with what we should

expect of the character of currents set up by chemical action going on between oxygenated saline solutions, and the veins themselves in which these experiments were conducted. The direction of these currents would vary according to the position of the positive element of the natural pair generating such current in relation to the other element, while, as a rule, in the case of stations connected at different levels, the current would be downwards, from the simple reason that the oxydizing of vein matters is more rapid and general as we approach the surface.

This is quite a different theory to either of those generally adopted to explain the origin of these currents; but the whole question of these "earth currents is involved in so much obscurity," so little data having been obtained in this direction, that no *decided* expression of opinion has been educed. On the other hand, scientific opinion seems to oscillate between the acceptance of two theories, attributing them either to magnetism or to thermal causes.

It is difficult, however, to account for these deep-seated currents by either of these theories; on the other hand, it is certain that in the natural decomposition of our metallic sulphides, we have a supply of electro-motive force amply sufficient to generate such currents; and, besides, currents so derived would, as before said, have those particular characters indicated by their first discoverer.

That each separate pyritous vein or mass with surrounding walls and exciting solution, may constitute, in fact, a true voltaic pair on a grand scale, competent for the development of various electric phenomena, including that of electro-deposition, has been more particularly the object of this paper to demonstrate.

In these sulphides, abundantly diffused in our rocks, we have immense stores of electro-motive force locked up, or now being liberated or developed by natural influences. So far as we *know*, they are the only source of chemico-electricity we have in nature, or, at least, of chemico-electricity of such intensity as to be able to deposit any of the metals instanced from their solutions.

I have only to add as a suggestion, that possibly a table like that above given, when amended and enlarged by further researches, may be useful to chemical geology in its attempts to ascertain the manner and order in which changes have been effected among the various constituents of our metalliferous lodes; since it shows by a *thoroughly* reliable and simple process, the relative tendency of certain sulphides to decompose as compared with others, in the solutions most likely to have had contact with them in the situations where they generally occur.

Art. XLII.—*On Certain Properties of the Tutu Plant* (Coriaria ruscifolia).*

By H. G. Hughes, M.P.S., Hokitika.

[*Read before the Wellington Philosophical Society, November* 12, 1870.]

During the past year I have devoted my leisure to the investigation of the properties of the Tutu plant, and communicated my results from time to time to Dr. Hector and Mr. Skey, who kindly assisted me with their criticisms. The following paper embodies a brief account of my experiments, which circumstances have unfortunately prevented my completing as I wished to have done.

About three-quarters of a pound of the fresh ground shoots were treated with successive quantities of distilled water slightly acidulated. After filtering and adding the acetate of lead in excess, it was submitted to the action of sulphuretted hydrogen, again filtered, and evaporated to the consistency of an extract. This extract was well washed with successive quantities of alcohol, filtered, evaporated, and ammonia added, when a precipitate resembling Kermes mineral was separated (resinous matter). It was still further concentrated, distilled water added, and again filtered from precipitate; evaporation continued, again treated with alcohol, filtered and evaporated to a syrupy consistence. On cooling, a few crystals formed with difficulty. This thick solution possessed very active properties, and a quantity of it, certainly not more than one-twelfth of a grain (I was scarcely aware of having tasted it), in five minutes time produced a most disagreeably irritating sensation in the throat, extending to the stomach, with pain across the region of the stomach, and accompanied by nausea. In a quarter of an hours time, vomiting came on, which continued more or less for two hours. Very unpleasant sensations continued for two hours more, when, after great flushing of the face, with all but intolerable heat, the effects passed away. Of course, not anything was taken to counteract the poison. On the addition of a little ether to the thick solution, a quantity of acicular crystals immediately made their appearance, but became redissolved as the ether slowly volatilized. The whole was afterwards shaken up with ether, the ethereal solution separated. Upon spontaneous evaporation, three or four drops of a fine yellow-coloured fragrant oil was as residue. The fragrancy increased upon the application of a gentle heat. Upon evaporating the thick alcoholic solution, crystals of supposed alkaloid formed. These were redissolved and recrystallized until their solution in alcohol was perfectly colourless. During the final evaporation of an alcoholic solution, an accident occurred, and they were lost, having been burnt. The residue was black and charred (carbonaceous).

---

* See former paper on same subject, by Mr. Skey. (*Trans. N. Z. Inst.*, Vol. ii., p. 153.)

The experiment was made with the view of isolating an alkaloid. A resin was separated (the powder before mentioned); it was combustible, burning with a clear flame. Besides, a bright yellowish-coloured fragrant oil. This fragrant oil was also obtained by distilling the expressed juice of the fresh and succulent young shoots. It comes over with the water, rendering it very fragrant. A solution of sodium chloride added to this fragrant water (it being previously shaken up with a little potash) immediately curdles it.

About three ounces of leaves were exhausted by percolation with precipitate and benzine successively. The benzine solution contained nothing of importance. The alcoholic solution was treated the same as that of the young shoots; it contained the fragrant oil, it was also poisonous, but lime was substituted this time for the acetate of lead. This time no alkaloid was found, and altogether it was a most unsatisfactory experiment. I thought the principles were lost.

Three-quarters of a pound of the bark was next examined. It was in a bad condition, and had been taken off a part of the trunk of a tree near the ground; it had been submerged during a flood of the Hokitika River. This was treated in the same manner as the young shoots, with the exception that lime was used, but yielded nothing besides a trace of the fragrant oil and some resinous matter.

Some of the seeds of the fruit (three quarters of an ounce), all that could be obtained the season being so far advanced, were macerated in alcohol and evaporated. To this alcoholic extract a little powdered lime was added and mixed. It was then well washed with spt. vin., ether, and chloroform, in succession. Neither of the latter two yielded anything upon spontaneous evaporation. The alcoholic solution evaporated; the residue was treated with acid sulph. dil. filtered, and pot. carb. added in excess caused a flocculent precipitate. The solution separated, the precipitate was treated with alcohol, and filtered. As the solution became more concentrated, a heavy olive-coloured oily fluid separated. Some shoots of the tree gathered 3rd December, 1869, yielded this oily fluid. It is of a most poisonous nature, half a drop administered to a terrier exciting most severe symptoms, (vomiting and convulsions). After further concentration, ether was added, when a yellowish precipitate formed, the oily fluid separating of a clear olive-green colour. As the ether volatilized the precipitate was redissolved by the alcohol; the oily fluid remained. Chloroform added caused a pure snow-white precipitate, which floated, the oil still remaining unaffected. It was then separated from the precipitate, dissolved in alcohol, and filtered. Upon evaporating spontaneously it deposited feathery crystals of a dingy colour (impure or contaminated with the oily fluid). Before all the alcohol had evaporated, chloroform always gave a pure snow-white precipitate. The crystals were extremely deliquescent. I thought this oily-looking fluid was a liquid alkaloid

similar to conia. It was soluble in alcohol, but insoluble in both ether and chloroform. The alcoholic solution of this oily substance and white alkaloid possessed very energetic properties,—an all but inappreciable quantity bringing on, almost immediately, a very distressing suffocating sensation, and an unpleasant feeling of roughness and insensibility of the palate. Not any of the fragrant oil was found.

Respecting the opinion that the oily-looking fluid is a liquid alkaloid, and at least holds in solution a salt (supposed alkaloid), the following may tend a little to uphold it.

It is very remarkable that this oily fluid is perfectly insoluble both in ether and chloroform, and soluble in alcohol and a mixture of alcohol and water; and whatever the poisonous principle or principles may be, that slacked lime made into a thin cream with water instantly destroys it or them, with or accompanied by the evolution of ammoniacal vapour. The fragrant oil is soluble in ether and chloroform, and I imagine it to possess emetic properties only, as will be seen when treating of the antidote.

Moreover, a portion of alcoholic extract was mixed with distilled water introduced into a pint retort, and heated in an oil bath. The extract was fragrant, and as a consequence, the fragrancy of the essential oil passed over with the first quantity of water as was intended and was removed. When the extract thickened, a good heat being applied (350° to 400° F.), I found snow-white acicular crystals sublimed in a ring all round the neck of the retort, two inches from the stopper. Watching how they formed, I saw drops of oily fluid, of an olive-green colour (the same oil apparently as that before mentioned), settling very curiously (as drops, I suppose owing to the repulsion of the glass from the high temperature employed, and the low degree of volatility of this oil), on the neck of the retort, which being very hot, these drops, as they slowly volatilized, left snow-white acicular crystals, and similarly to those before mentioned, extremely deliquescent, and very soluble in alcohol. Some were preserved, mounted, and examined with the microscope, and I thought they were oblique rectangular prisms. As far as I was able to judge, these were exactly similar to those before described as having been lost. I imagine that the charring of the first ones, and the extreme deliquescence of these, altogether set aside the opinion of their being ammonium chloride, which was suggested to me by Mr. Skey. The crystals taken from the neck of the retort gave precipitates with the iodide of mercury and tannic acid respectively. An unused portion of the extract experimented upon, was treated with slacked lime (it was the first time that slacked lime was used), when strong ammoniacal vapour was discharged, and the extract became a solid mass. Suspecting the alkaloid, or whatever it was, to be destroyed, just as anticipated, although great and unusual care was used towards isolating the various principles, yet not a trace of anything was found, as was the case with the other portion subjected

to distillation with water. It was from the consideration of this strange reaction that it occurred to me that lime would be of avail in cases of poisoning.

From another quantity of the shoots of the tree, crystals were obtained of a very mixed character, which gave precipitates with iodide of mercury, also the bichloride of mercury. These had a very peculiar taste, saline and bitter, and very biting, and were poisonous, half a grain causing slight nausea and exciting symptoms similar to the oil, but milder.

In all my experiments, the ether, alcohol, chloroform, etc., used, were the commercial articles.

Respecting the efficacy of a mixture of lime and water in cases of poisoning, and before giving the report by Dr. G. H. Acheson, of this town, it may be as well to state that nothing was administered by way of general treatment, the antidote only was given, besides what takes place when a mixture of cream of lime with water is added to the simple extract of tutu rendered fluid with a little water and mixed. The extract was prepared by macerating the young, but woody and developed, shoots in water, acidulated with acetic acid, and applying a gentle heat, pressing, and evaporating to the consistency of an extract. These shoots yield extract more poisonous than the succulent ones. Having to handle these wet shoots rather frequently, induced vomiting. The day the extract was prepared, its admixture with lime gave strong ammoniacal vapour. It was very poisonous. About half a scruple was given to a cat; I was obliged to leave her, and on my return, in twenty minutes time, found her dead.

On the second day the reactions were similar.

On the third day after preparation, the ammoniacal vapour was just perceptible, but readily detected by fumes of hydrochloric acid; it was but slightly poisonous.

On the fourth day the extract had become much thinner, gave no ammoniacal vapour, and was not in the least poisonous.

The extract preserved its original consistency until the third day, when it became soft, which condition was much increased by the fourth day. During this time the weather was fine; I do not think the atmosphere was more humid than usual. Three extracts prepared at intervals of five or six days, and in succession, behaved in a similar manner.

When the cream of lime is added to good (poisonous) extract, it coagulates or thickens, and appears to swell immediately, strong ammoniacal vapour being at the same time evolved. Should the extract possess fragrancy, owing to some of the fragrant oil not being dispelled during the process of preparation, it is at once destroyed by the lime. It is important to observe that the inert extract on the fourth day after preparation, retained this odour. From what I have seen of its action, it possesses emetic properties only.

Recapitulation.—Acetic acid fixes or preserves the poisonous property (for a time at least), arresting its decomposition. When lime is added to good extract (poisonous), strong ammoniacal vapour is evolved; but on the fourth day, in the lime mixed with it, although possessing the odour of the essential oil, not the slightest trace of ammonia can be detected, the oil also, when destroyed by the lime, not giving any ammoniacal vapour, indicates it to be of a different composition, and a non-nitrogenous oil. The decomposition of the poisonous principle, resulting in the evolution of ammonia, shows nitrogen to be present in it. The fragrant oil comes over at 212° F., the poisonous principle at between 350° and 400° F. The spontaneous decomposition of the extract was carefully watched; there was no other perceptible change than its assuming a more fluid condition.

From what has been stated, it is observable that the poisonous principle is very unstable when in a state of extract, decomposes immediately when neutralized with lime, and is fixed (for a time at least) by acetic acid.

When the treatment of the plants was prolonged the results were variable and of an indifferent character, which I attributed to the principles decomposing spontaneously when in the presence of water. Also, as the season advanced the results were less satisfactory, as if indicating a smaller amount of the various principles—that is with reference to the shoots, bark and leaves.

The young ground shoots (plants growing from the ground) gathered in March, 1869, yielded most of the supposed alkaloid and the other principles. They were, besides, more woody than those subsequently examined. The last examined were collected on the 3rd of December, 1869, and were shoots of the tree, but no trace of alkaloid was found, perhaps owing to the above mentioned supposition. They were macerated for at least twenty-four hours in distilled water, with the application of a gentle heat.

Report of Experiments made by Dr. Acheson, with a mixture of Slacked Lime and Water as the Antidote for Tutu Poison.

"For some time past I have been experimenting on various animals with a watery extract of tutu, prepared by Mr. Hughes, pharmaceutical chemist, of this town, and, at his request, I now state the result.

"I administered to a cat, fifteen grains of the extract; twenty minutes after, the respiration became very frequent, slight twitching of extremities, and in five minutes more, a severe attack of convulsions, which lasted about three minutes. Then, an interruption of ten minutes, followed again by a severe paroxysm, which lasted four minutes; again intermission of ten minutes, which was followed by a severe paroxysm of pure tetanic spasm, in which she expired. In this case, from the commencement of symptoms of poisoning the slightest noise would invariably excite a recurrence of the paroxysm.

"2nd. I administered to a large dog half a drachm of the extract. Fifteen minutes after, breathing hurried, fœces expelled, vomited several times so severely that I was perfectly persuaded that the poison had been expelled. At the expiration of thirty minutes, tremors and slight twitching of the muscles of the extremities and very much afraid to move out of one position. Then a severe paroxysm of convulsions, gnashing of teeth and frothing at the mouth, the paroxysm lasting about four minutes, then a remission of ten or twelve minutes, which was followed by the most severe and final paroxysm.

"In the above two cases, the extract had been prepared but two days.

"3rd. On the afternoon of the third day after the preparation of the extract, I administered the same quantity to a similarly sized dog. At the expiration of thirty minutes, it having produced no effect, repeated the dose in a *fluid* state. The double dose merely produced sickness and slight tremor.

"On the fourth day the extract had become very thin and watery, which led me to suppose that spontaneous decomposition had destroyed its poisonous property. I therefore increased the dose to two drachms, yet no symptom of poisoning.

"A few days after the above mentioned experiments were made, I, with the assistance of Mr. Hughes, administered about a drachm of fresh extract to two dogs. To one of the dogs the extract was given in a mixture of lime and water. It remained in the stomach for several minutes before vomiting commenced. After the expiration of half an hour from the cessation of vomiting, we determined to administer a drachm of the extract alone, being merely dissolved in a little water. This he retained for twenty minutes without any vomiting taking place. We then administered to him a quantity of lime mixture. He never showed the slightest symptom of poisoning. To the other dog the extract was given in a quantity of water merely. A few minutes after administration, symptoms of poisoning commenced, and in twenty minutes he had a regular attack of pure tetanic convulsions. Immediately after the first paroxysm, we emptied into the stomach a quantity of the lime mixture, after which he had one severe fit, from which he recovered rapidly, and in the course of a very short period he was perfectly free from all symptoms of poisoning.

"We administered to a rabbit about thirty grains in the solution of lime, it never evinced the slightest symptom of poisoning.*

"In every case in which we administered the lime mixture the animal recovered rapidly, and when the extract was active it invariably gave fumes of ammonia on being mixed with lime.

* Tutu does not act as a poison upon rabbits. I kept two of them for two days feeding upon tutu leaves, and afterwards gave them several large doses of the poisonous extract. I thought one of them appeared a little stupefied, but it would eat well enough notwithstanding.

"From what I have seen I am perfectly persuaded that lime is an antidote against the tutu poison; also, that by the fourth day of the watery extract it is almost inert.

"In every case experimented upon the animal remained perfectly conscious, indeed, the mode of attack and the appearance of the animal while in a paroxysm, strongly resembles poisoning by strychnia.

"G. H. ACHESON, F.F.P.G.

"Hokitika, April 5, 1870."

TUTU AS A DYE-WOOD.

Some woollen material, silk, and linen, were boiled for a short time (half an hour to an hour), with some chips (the wood of the tree), afterwards treated with a hot solution of copperas. The colours were pure, from a neutral grey to a deep black, the dye varying in intensity according to the number of times the material was treated with the decoction of the wood. The dye is superior to that of logwood, inasmuch that it is pure. Woollen materials take it readily and well, silk is not so readily affected, and linen takes more time. The wood of the tree may be used as a substitute for logwood, and this property of the wood of the tree may be studied to advantage and profit.

[The results given in the above paper being somewhat at variance with those obtained by Mr. Skey (*loc. cit.*), they have been carefully re-examined in the Laboratory, and Mr. Skey is of opinion that some of the reactions cited by Mr. Hughes are not satisfactory, for the following reasons:—

1st. That the oil under examination must have been saponified by the processes employed.

2nd. That the temperature used was such as must have produced many side products by destructive distillation, and, among others, acetate of ammonia, the presence of which would sufficiently account for the reactions Mr. Hughes attributes to the presence of an alkaloid.

3rd. That the action of lime, as an antidote, is not due to its decomposing an alkaloid, but to its forming an insoluble soap with the poisonous oil; and Mr. Skey still adheres to his opinion, that dilute acids should be administered in cases of poisoning by tutu.

4th. That the dyeing properties of the juice of the tutu plant are due solely to the abundance of tannin they contain, and are not analogous to the special dye principle of logwood (hæmatoxyline), for which reason he does not think that it can be used for dyeing any shade to which tan bark is not equally applicable.

Mr. Skey's views are explained in a paper, which must be deferred for future publication.—ED.]

IV.—GEOLOGY.

Art. XLIII.—*On the Relative Ages of the Waitemata Series and the Brown Coal Series of Drury and Waikato.* By Captain F. W. Hutton, F.G.S.

(With Illustrations.)

[*Read before the Auckland Institute, August* 8, 1870.]

The only geologist who has hitherto published any classification of the tertiary rocks of the central part of this province is, I believe, Professor Hochstetter. In his lecture delivered in Auckland, in June, 1859, he divides the strata into two formations:—

1st. A younger, probably Miocene, comprising the series of clays and sandstones upon which Auckland stands, and which he called the "Waitemata series," and

2nd. An older one, probably Eocene, which is found principally on the west coast, and in the interior, on both sides of the primary ranges.

This older formation he again subdivides into—

1. Sandstones of the Upper Waipa and Mokau.
2. Limestones of the Upper Waipa and Mokau, of Raglan, Kawhia, Papakura, and south of Port Waikato.
3. Clays and green sandstones on the eastern branches of the Raglan, Aotea, and Kawhia harbours.
4. Brown coal series of Drury and Lower Waikato.

Subsequently, in 1865, in the Geology of the *Voyage of the "Novara,"* he appears to have altered his views as to the relative ages of the beds as follows:—

1. Limestones of the Upper Waipa and Mokau.
2. Shales and limestones of Raglan, Aotea, and Kawhia.
3. Sandstone of Port Waikato.
4. Limestone of Papakura.
5. Waitemata series.
6. Brown coal series of Drury and Lower Waikato,

And in the map accompanying that volume, the rocks are divided into two formations—the younger containing Nos. 1, 2, 3, and 4 of this table, and the older Nos. 5 and 6.

During the month of November, 1866, I was employed by the Provincial Government to ascertain the probable limits of the Brown coal series in the Lower Waikato, and while thus engaged I was led to form a different opinion of the relative ages of the tertiary rocks to either of those proposed by Professor Hochstetter; consequently, in the report I then sent in, I altered his arrangement to suit my views, but as I had no idea at the time it was written that it would be published, I gave no reasons for my alterations.

I therefore propose now to place on record the evidence in favour of the conclusions I then arrived at, and which I have since seen no reason to alter.

Commencing with the Waikato coal field, we find on the right bank of the river, just opposite to the present mine, the section given by Professor Hochstetter in his *New Zealand*, p. 302, of the Brown coal series resting unconformably on the old slate formation of the Taupiri Range. The left bank of the river shows a somewhat similar section, the slate rocks being seen in the bed of the river, below the mine. At the mine, the coal series consists of—

1. Yellow sandy clay, with nodules of clay ironstone .	230 +	feet.
2. Upper fire-clay, dark blue	12–14	"
3. Shale, with leaves of dicotyledons	4	"
4. Brown coal	12–18	"
5. Lower fire-clay, light blue	20	"
6. Light coloured clays, with ironstone . . .	30–100 +	"

The fossils found in the bed No. 3 are leaves of dicotyledonous plants only; they are probably abundant, but it is only when the roof of the coal is being worked that they can be obtained. None of them have as yet been described. About seven miles west of the river, the coal series ends abruptly, and beds of calcareous sandstone rest on its denuded slopes. (Section I.) This sandstone belongs to a series extensively developed on the west coast, which, in my report previously alluded to, I called the "Aotea series." It consists of—

1. Crystalline and tabular limestone of Raglan and Kawhia.
2. Calcareous sandstone of Aotea and Port Waikato.
3. Sandy clay of Aotea and Raglan, passing into marl further north.
4. Limestone south of Port Waikato.

Its characteristic fossils are *Schizaster rotundatus*, Zitt.; *Ostrea Wullerstorfi*, Zitt.; *Pecten athleta*, Zitt.; *P. Burnetti*, Zitt.; *P. Williamsoni*, Zitt.; *P. Hochstetteri*, Zitt.; *Cucullæa singularis*, Zitt.; *Scalaria lyrata*, Zitt.; two species of *Dentalium*, and *Cristellaria Haasti*, Stache. The upper parts are recognized by *Pecten Burnetti*, *Scalaria lyrata*, and *Ostrea Wullerstorfi*; the lower by *Cuculæa singularis* and the two species of *Dentalium*. *Foraminiferæ* abound, especially in the lower part of the series, and these have been considered by Dr. Stache to indicate an age about equivalent to that of the Mayence Basin, which is classed as Lower Miocene by some geologists, and as Upper Eocene by others. Of twelve species of shells from this series, one only, *Waldheimia lenticularis*, Desh., is recent.

Lying unconformably on the top of the Aotea series is a mass of reddish yellow sandstone, interstratified here and there with seams of bluish clay, containing indistinct plant remains, *e. g.*, between Kaha and Kara Points, and north of Waikorea. The sandstone itself appears to be devoid of fossils, with the exception of a few impressions of dicotyledonous leaves, which I found near Kaha. Further north, at Nga-tutura, it is seen to be broken through by

a volcano, and covered with tuffs and basaltic lava streams. This sandstone I suppose to be the equivalent of the Waitemata series, for reasons which will appear further on.

Passing now to the Drury coal field, we find at the abandoned works of the Waihoihoi Coal Mining Company (Section II.) the Brown coal series dipping slightly N.W., and resting upon an uneven floor of dark blue sub-metamorphosed sandstones, in all probability of the same age as the slates underlying the Waikato coal field. The series here consists of—

1. Light grey clay	
2. Brown coal, more or less impure	5 feet.
3. Light grey clay	20 „

The coal crops out on the western slope of the Hunua Range, facing the Manukau, and at the base of the slope there is a series of quarternary, red, yellow, and white clays (f.), about fifty feet thick, which are underlaid, in all the borings yet made, by boulders, or flows of vesicular basalt containing chalcedony in its cavities. Further west, at Slippery Creek, near Drury, a bed of dark blue or green volcanic ash, that weathers reddish brown, is seen to underlie these clays. This rock is similar in appearance to the bed of tufa in the Waitemata series seen in the cliffs below Parnell. Whatever may be its age, it is probable, from its position, that it is younger than the Brown coal series.

Passing on further north, to Papakura, we find the coal series to consist of—

1. White sandstone, chocolate at the base, with nodules of clay ironstone	50 + feet.
2. Brown coal	4 „
3. Clay, with ironstone	3 „
4. Shale, with leaves of dicotyledons, and *Anodonta elliptica*, Hoch., MSS.	30 „
5. Brown coal	6 „
6. Yellow clay	? „

It is here broken by faults and dips at various angles. (Section III.) Resting unconformably upon it, we see, at Campbell's old saw mill, a mass of soft green sandstone. Still further north, the coal series has been washed away, and on its slopes has been deposited the group of sandstones and limestones which I here call the Papakura series. (Section III. c.) This series is found at Cruickshank's quarry at a higher level than the coal, dipping 8° N.W., and a little east of Papakura it is seen at the level of the Manukau flats.

At Cruickshank's quarry it consists of—

1. Fine-grained grey sandstone	50 + feet.
2. Blue and yellow sandy clay, with fossils *Waldheimia gravida*, *Turbinolia*, etc.	3 „

3.	Crystalline limestone	5 feet.
4.	Blue or green soft sandstone, weathering grey, with marine shells, and, according to Hochstetter, leaves of dicotyledonous plants	? ,,

Behind Mr. William Hay's house, the series consists of—

1.	Grey sandstone.	
2.	Calcareous grit, with fossils	3–6 feet.
3.	Limestone; thins out to S.W.	5 ,,
4.	Soft green sandstone, with fossil wood and leaves, pieces of coal and worm-borings (*Teredo Heaphi ?*)	? ,,

The whole dipping 10° N.N.W.

There can, I think, be little doubt but that No. 4 in both these sections represents the same bed, and that the mass of green sandstone seen at Campbell's mill is also a portion of the same, and, therefore, that the Papakura series rests unconformably on the Drury coal series.

Section III. represents a diagrammatic section through the district, and gives a combined view of the sections at Campbell's mill, Cruickshank's quarry, and behind Mr. Hay's house. It is one of the most important sections in the province, as it is probably the only one that shows the relations between the Waikato and Drury coals on the one hand, and those of Whangarei and the Bay of Islands on the other.

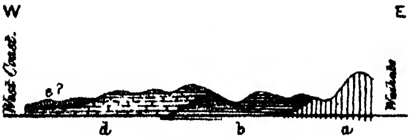
Passing still further north, to the district between the Wairoa and Howick, we find horizontal dark-green soft sandstone, with thin seams of coal and traces of plants, together with *Foraminiferæ* (*Globigerino bulloides*, etc.), lying unconformably on the older sub-metamorphosed slates and sandstones of the hills west of the Wairoa. There can be no doubt but that this green sandstone (Section IV. c.) is the same as No. 4 of the Papakura series, as it is petrographically identical, and distant only a few miles. Travelling to the west, we find, at Turanga Creek, the water-worn surfaces of this green sandstone covered by a series of yellow clays and sandstones (Section IV. e.), which can be traced through Howick to Auckland, and which form part of the Waitemata series of Professor Hochstetter. These beds are generally devoid of organic remains, traces of plants and seams of lignite being the most common; but, at Orakei, three small *Pectens* and other marine shells have been found, together with large quantities of *Bryozoa* and *Foraminiferæ*. Professor Rupert Jones is of opinion that the *Foraminiferæ* indicate a late tertiary period (*Quar. Jour. Geo. Soc.*, Vol. xvi., p. 251), and Herr Karrer thinks that they indicate an Upper Miocene age, while Dr. Stoliczka thinks that the *Bryozoa* indicate an Upper Miocene, or, perhaps, Older Pliocene age.

It thus appears that the Drury coal series is overlaid unconformably by

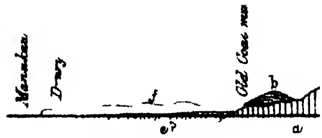
the Papakura series, which, in its turn, is also overlaid unconformably by the Waitemata series. Also, that the Waikato coal series is overlaid unconformably by the Aotea series, which, in its turn, is also overlaid unconformably by reddish yellow sandstone with beds of blue clay containing plant remains, and we have now to try to connect the two and see what is the parallelism between them.

The Waikato and Drury coal fields both lie on the same flank of the same range of old slate hills, the hills of Pokeno, Razor-back, etc., which divide the Waikato from the Manukau being of much more recent date, so that at the time when the coal was forming they were both on the same shore of probably a large lake or lagoon. Intermediate patches of coal occur between the two on the Maramarua, and near Paparata, and although that of the Waikato is the best and purest, because coming from the largest seam, the coal at all these places is of the same class, and does not differ more than different parts of a large coal field might be expected to do. The fossil leaves found both at Waikato and Drury are dicotyledons. Those from the former place have not yet been described, but Dr. Hector, I believe, is of opinion that there is no species common to both, but as only seven species have been found at Drury, and probably only four or five at Waikato, this evidence is not of very great weight, especially as at Drury four species were found on Mr. Pollock's land, and four on Mr. Fallwell's, and only one of these, *Fagus Ninnisiana*, Ung., was common to both. It is therefore probable that at one time the coal extended from the present mines in Waikato, over Waikari Lake, across the Valleys of the Whangamarino and Maungatawhiri to the Drury mines, and perhaps to the Wairoa River, but that by far the greater part of it has been washed away, patches only being left here and there, although it may still exist below the Razor-back and Pokeno hills.

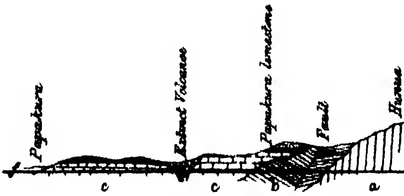
With regard to the corelation of the Aotea and Papakura series, the palæontological evidence is scanty. Professor Hochstetter mentions *Schizaster rotundatus*, *Pholadomya*, sp., and *Turbinolia*, sp., as common to both formations, and to these I can add two others, viz., *Pecten Fischeri*, which I found at Port Waikato, and *Pecten*, sp., belonging to the group *P. pleuronectes*, which is common in the base of the Aotea series. These are, however, enough to show that the two series are either equivalents, or very nearly on the same horizon, and I am inclined to think that the Papakura series forms the base of the Aotea series. I have also found a *Turbinolia* in green sandstone, at Whangarei Heads, which, as far as I can judge, appears identical with one I found at Papakura, and Dr. Hector informs me that *Pecten Hochstetteri* has been found in the green sandstone overlying the coal at Whangarei, and *Lamna* teeth are found at Whangarei and Aotea; it is therefore probable that the coal at Whangarei and the Bay of Islands is of the same age as the Papakura series, and, if such should be the case, it would appear that while the Aotea



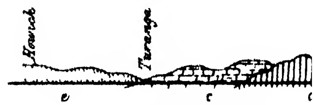
Sec I 18 miles



Sec II 5 miles



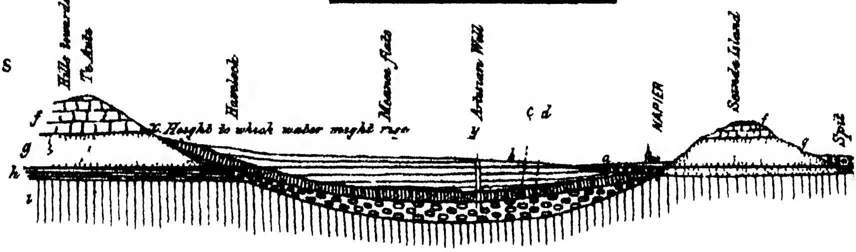
Sec III 6 miles



Sec IV 6 miles

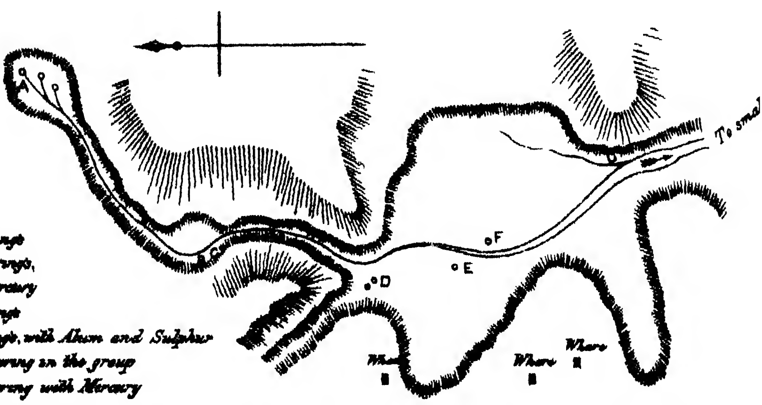
REFERENCE

a Older slates and sandstones
b Brown coal series
c Papakura series
d Aotea series
e Waitemata series
f Quaternary clays



SECTION THROUGH THE MEANEE FLATS NAPIER

a Recent shingle bed
b Alluvial sands
c Blue clay, with lignite and trunks of trees (Totara Matai)
d Old shingle bed
f Shelly limestone
g Soft sandstone
h Blue shale
i Clay slates and sandstones, with jasper



A Cold springs
B } Warm springs,
C } with Mercury
D Cold springs
E Hot springs, with Alum and Sulphur
F Hottest spring in the group
G Warm spring with Mercury

SKETCH of some HOT SPRINGS near the BAY of ISLANDS

series increases in thickness from Port Waikato southwards, the Papakura series increases in thickness from Papakura northwards.

Professor Hochstetter, when assigning a position to the Papakura series, appears to have been too much influenced by the apparently intermediate character of its fossils, between those of the Aotea and Waitemata series, so that when, in his lecture, he placed the Waitemata series in its true position, he made the Papakura series younger than parts of the Aotea series, and when he subsequently classed the Waitemata series with the Brown coal, he placed the Papakura series in its probably true position below the Aotea series.

The connection between the Papakura and Waitemata series was supposed to consist in the occurrence of *Pecten Fischeri*, *Pecten*, sp., group *pleuronectes*, and casts of *Vaginella* in both, but Dr. Zittel has expressed doubts as to the specific identity of the Orakei *Pectens* with those from Papakura, and I have since found both species in the Aotea series, so that the connection now rests solely on the supposed casts of the interior of *Vaginella* shells being found in both.

That the sandstone that overlies the Aotea series on the west coast between Port Waikato and Raglan, is to be referred to the Waitemata series, is not so certain, the only reasons being that both are nearly destitute of fossils, except traces of plants, and both lie unconformably on the closely-related Aotea and Papakura series, while they are also both anterior to the basaltic outbursts. The interval, however, between these dates is far too great to speak with confidence on the synchronism of the two; all that can be said at present is, that if the West Coast beds are not the equivalents of the Waitemata series, they are probably younger than them.

COMPARISON between the PROPOSED ARRANGEMENT of the ROCKS with those of PROFESSOR HOCHSTETTER.

Hochstetter.		Proposed.			Probable age.
Lecture.	Book.				
1	4	1	Waitemata series		Upper Miocene
			UNCONFORMITY.		
2	1	2	Limestone of Raglan and Kawhia		
	2	3	Sandstone of Pt. Waikato & Aotea	Aotea series	
3	1	4	Clays of Raglan, Aotea, &c.		Oligocene.
2	3	5	Papakura series		
			UNCONFORMITY.		
4	5	6	Brown coal series		Eocene.

Art. XLIV.—*On a Carbonaceous Mineral from Whangarei Harbour.*

By Captain F. W. Hutton, F.G.S.

[*Read before the Auckland Institute, September* 12, 1870.]

At One-tree Point, on the western side of Whangarei Harbour, a carbonaceous mineral, resembling coal in appearance, occurs under such curious circumstances that I think a short notice of it will prove interesting.

One-tree Point consists of low cliffs, some twenty feet high, of soft horizontal quaternary sandstones, with casts of marine shells (*Pecten*, etc.) The upper stratum is yellowish sand, the middle one more ferruginous, while the lower one is blackish or brown, from the quantity of carbonaceous matter scattered through it. On the face of the cliffs, several irregular oblique fissures, from one to six inches in breadth, are seen traversing all the beds. These fissures are generally filled up with sand, but some of them, when they enter the dark coloured lower stratum, are filled with carbonaceous matter, which is much mixed with impurities near the sides of the vein, but in the centre is nearly pure. Sometimes the centre of the vein is empty, with the pure carbonaceous mineral lining both sides. These fissures are similar to ordinary veins, and do not bear any resemblance to holes made by roots of trees, etc.

The mineral from the centre of the vein has very much the appearance of cannel coal. Its colour is black, with a shining resinous lustre. Streak and powder black. Very brittle, but does not dirty the fingers. Hardness about 2. In the flame of a spirit lamp it burns to a white ash without altering its shape, and without giving off any odour or smoke, but it will not burn if taken out of the flame. It appears to be nearly pure carbon, without any admixture of bitumen.

These phenomena appear to me to be inexplicable, except by supposing that the carbon has passed in a state of solution from the sandstone into the fissures, and that it has then been deposited on the sides of the veins. If the process had been one of sublimation, the mineral would also be found at a higher level than the upper surface of the dark coloured sandstone, which is not the case. And if both it and the carbonaceous matter that colours the sandstone had been sublimed from below, and impregnated both the vein and the rock, it is evident that the vapour would have ascended further up the fissure than through the rock. What, however, the solvent could have been I cannot even conjecture. Specimens of this mineral were forwarded to the Colonial Museum by me, in 1866. See *Colonial Museum and Laboratory Reports*, 1866–67, page 17.

[The following is the composition of the carbonaceous mineral, which appears to be a non-caking lignite approaching jet, burning with difficulty, giving but little flame and a white ash :—

Water	32·2
Fixed carbon	34·2
Hydro-carbon	17·0
Ash	16·6
	100·0—J. HECTOR.]

ART. XLV. — *On the Artesian Wells near Napier.* By Captain F. W. HUTTON, F.G.S.

(With Illustration.)

[Read before the Auckland Institute, September 12, 1870.]

IN July, 1867, during a short visit to Napier, I paid particular attention to the Artesian wells which, just then, were being sunk on the Meanee Flats, and I think that a few remarks on their origin may be found useful.

The hills south of Napier are composed of limestone and sandstone, underlaid by a stratum of blue shale, of late tertiary age, the whole resting upon clay slates, sandstones, and jasperoid slates, of a much older date. These tertiary rocks have been denuded away towards the sea, leaving, as an outlier, Scinde Island, at the foot of which the town of Napier is situated. The hollow thus left between Napier and the hills has been filled up with river alluvial deposits, which now form the Meanee Flats, and it is on these flats that the Artesian wells have been sunk. These deposits consist of alluvial sands lying upon a bed of blue clay, in which trunks of trees (matai, totara, etc.) are found, and below the clay is a layer of gravel or shingle. When the wells have been sunk through the first two deposits, and penetrate into the gravel, the water rises in the bore-hole, sometimes to a height of twenty-six feet above the surface.

The origin of the wells is as follows:—The rain falling on the porous limestone and sandstone hills, soaks through them until it is arrested in its downward progress by the impervious stratum of shale; it then runs into the lowest shingle bed of the alluvial deposits, which it fills. The water being prevented from rising to the surface by the bed of blue clay, has no means of escaping, and when the shingle bed is filled, it rises in the hills until they are saturated up to the point (x) where the blue clay bed rests upon the sand stone and limestone; it then runs over in springs. When, therefore, the blue clay bed is pierced by a well, the water in the shingle bed is forced up by the hydrostatic pressure of the water in the hills, and overflows at the surface, or rises above it, according to the amount of the pressure; but in no case can it rise above the level of the junction of the upper surface of the blue clay with the limestone, or the line (x y) in the section.

It is therefore apparent that unless the clay is pierced no Artesian well will be found, and that when the boring reaches the slate rocks without getting water, it may be abandoned as useless.

Art. XLVI.—*On the Occurrence of Native Mercury near Pakaraka, Bay of Islands.* By Captain F. W. Hutton, F.G.S.

(With Illustration.)

[*Read before the Auckland Institute, October* 10, 1870.]

A few miles south-east of the Omapere Lake, near the Bay of Islands, lies a group of hot and cold springs, of great interest on account both of the peculiar mineral character exhibited by them, and the deposits of mercury and cinnabar that some of them form.

As long ago as 1866, it was known that mercury had been found at these springs, but, as only very small quantities had been obtained from one spot alone, it was the general opinion that some person had broken a thermometer when taking the temperature of the water. Having, however, been informed that small grains of cinnabar had also been found in the sand, I was induced, in June, 1869, to make a visit to the place. This visit, owing to circumstances over which I had no control, was unfortunately a very hurried one, and limited to a few hours only, but, thanks to the guidance of my friend, Mr. Henry Ireland, of Waimate, it was very successful, for not only did we find mercury in the sand in the place already alluded to, but also in two other localities, in veins in the rock, accompanied by cinnabar and sulphur.

The series of springs which I have to describe are, I believe, the most important in the district, although many others exist. They commence with a group of large cold springs (A), situated in a crateriform hollow in low undulating fern-covered hills composed of brown, soft, argillaceous, thin-bedded sandstone, with occasional beds of lignite. These rocks are probably not of an older date than Upper Miocene, and may be even of Pliocene age. After leaving this hollow the stream flows through a narrow gorge, about a quarter of a mile in length, which opens out into another small hollow, in which, among others, some warm springs are found (B and C), containing mercury and sulphur.

The stream then flows through another gorge, and again emerges into a level irregularly-shaped hollow, of much larger dimensions than either of the others, in which numerous springs, both hot and cold, are situated. On leaving this hollow the stream flows through a narrow passage, and empties itself into a small lake.

The water of this stream both smells and tastes strongly of sulphuretted hydrogen, and is decidedly acid. Most of the springs are cold, some are tepid, and a few, situated in the centre of the last and largest hollow (E and F), are hot, but the temperature of the hottest of them is probably not much more than 120° F. In one of these hot springs (E), deposits of alum and sulphur are found; many of them show traces of sulphur, and almost all have deposited silica, although not in large quantities.

We commenced our search at the place where mercury had previously been found (marked G on the sketch), but for some time without success, owing to the soil having been a great deal disturbed by former explorers; at last, after turning aside the small stream that here joins the larger one, and carefully washing in a tin plate the grit in its bed, we succeeded in obtaining a few specks of cinnabar and a few small globules of mercury. Thus encouraged, we continued our search, but with only moderate success, and as it was getting late, we thought it advisable to examine other localities, in order more effectually to test the thermometer theory. Accordingly, we crossed over the hills to the sources of the stream (A), but in our necessarily hurried examination, could find nothing. We then followed down to the second hollow, and began, a little before dusk, trying the spot marked B, where we at once found grains of mercury in the sand, and on continuing our search, we discovered a small vein in the soft decomposing sandstone. This vein was from a quarter to half an inch in width, open in the centre, and lined on each side by a black ore of mercury, and contained, both in the lining and centre of the vein, globules of mercury, often of considerable size, and accompanied by deposits of sulphur. Soon afterwards we found a precisely similar vein a few yards distant (at C). Mercury was also distributed in fine globules through the rock on each side of the veins, and on breaking this down and washing it in a small tin plate, I obtained about two-thirds of an ounce in half an hour, besides many small angular grains of red cinnabar. Much of the mercury, however, escaped me (perhaps an equal quantity to that which I obtained), for the particles were so minute that much of it floated on the surface of the water, and refused to run together. Even the larger particles amalgamated with difficulty, owing either to the sulphur, or to a black greasy hydro-carbon, which is found at all the springs where mercury occurs, and which may be derived from the lignite beds at or near the surface, or may have a deeper origin.

The black mineral found in the veins is a sulphide of mercury with some iron. It is insoluble in boiling nitric or hydrochloric acids, but dissolves readily in aqua-regia. It is generally black and dull, but sometimes the colour is lead grey, and the lustre sub-metallic. Streak metallic, lead grey, powder black, sometimes mixed with particles of red, or reddish black. Hardness about 5. S.G. = 9·224. Before the blow-pipe it gives a greenish yellow bead, with borax.

I also took home with me a small bottle of water from the spring at G, and found it to contain zinc, manganese, silica, and free sulphuric and hydrochloric acids. I could obtain no trace of mercury. The specific gravity of the water was 1·04. On passing sulphuretted hydrogen through it no precipitate was formed, but it turned a beautiful pale blue colour, very like that of Te Tarata, and other hot springs in the interior of the island.

ART. XLVII.—*On the Physical Geography of the Lake Districts of Otago.* By JAMES M'KERROW.

[*Read before the Otago Institute, July 19, 1870.*]

THE Lakes of Otago belong principally to the two great river systems of the Clutha and Waiau. Lakes Hawea, Wanaka, and Wakatipu, belonging to the Clutha River, and Lakes N. and S. Mavora, Te Anau, Manipori, and Monowai, to the Waiau River.

These lakes are of great extent relative to the size of the country. Taking their dimensions from the reconnoissance surveys, we have for the Clutha River system :—

	Length in miles.	General breadth in miles.	Area in sq. miles.	Alt. above sea level in feet.
Lake Hawea . .	19 .	3 .	48 .	1189
Lake Wanaka . .	29 .	1 to 3 .	75 .	974
Lake Wakatipu . .	50 .	1 to 3½ .	114 .	1069
			237	

For the Waiau River system :—

	Length in miles.	General breadth in miles.	Area in sq. miles.	Alt. above sea level in feet.
Lakes N. and S. Mavora	9 .	½ to 1 .	5 .	2073
Lake Te Anau .	38 .	1 to 6	. 132 .	694
The three western arms or fiords of Te Anau, each	10 to 18 .	1 to 3		
Lake Manipori .	18 .	½ to 6 .	50 .	597
Lake Monowai .	14 .	½ to 1 .	. 11	not over 500

It may here be noted that the Te Anau is the largest lake of the Middle Island.

The lakes are all known to be many hundreds of feet deep, but no great attention has been given to the sounding of any of them, excepting Lake Wakatipu. Soundings of this lake have been taken by several persons independently. The greatest depth given is 1400 feet, about the middle of the lake off Collins Bay, and sixteen miles from the south end of the lake.

Having stated the principal survey data of the lakes, we may now refer to the map for their relative positions. It will appear that they all lie along the eastern side of the great western ranges, or Southern Alps; as also Lakes Ohau, Pukaki, and Tekapau, of the Waitaki River system.

It may also be observed that the lakes of Otago and Canterbury, taken as a whole, lie on a line which is roughly parallel to the axis of the Southern Alps, and to the west coast. The length of the lakes greatly exceeds their breadth, and they all lie lengthwise in their valleys, and occupy the full width of the valley, the mountains rising generally from their shore line. Their surfaces do not differ greatly in altitude above sea level, and what difference there is

seems to have a relation to the height of the mountains [the lakes of greatest elevation being in the valleys running down from the highest mountains.] The lakes terminate just where their valleys begin to widen out into plains. Along their sides, and at their southern ends, there are invariably vast collections of shingle and large blocks of rock.

From these similarities it is evident that some great natural cause or law has had a uniform action over this 300 miles of country in producing the lakes.

An observer might have these facts at his command, and yet be sorely puzzled to account for the origin of the lakes, if he had no access to the records of Arctic or Antarctic discovery, or to the Alpine researches of such philosophers as Agassiz and Forbes. But with these as guides, it is plain that the glaciers which now lie far up the valleys and ravines of the mountains are, comparatively speaking, the puny descendants of glaciers that formerly filled valley and lake beds with their vast dimensions, and in their slow but irresistible march, carried forward the spoil of the mountains, and deposited it as lateral and terminal moraines.

Accepting this explanation of the glaciers at one time filling the present lake basins, the question arises: Did the glaciers excavate the basins, or did they simply occupy them for a time, as the lakes now do?

In how far a glacier could excavate a valley out of rock, is necessarily a question very much of speculation. It will be of interest, however, to endeavour a general demonstration of the effect. In a paper read before this Society by Mr. Beal,* attention was directed to the wearing power of ice in motion, and to the rounded outline of the hills so operated on. As an illustration of this action, Peninsula Hill, near Queenstown, was mentioned. This hill is 1700 feet above the level of the lake surface, or about 3000 feet above its bottom. If, then, we suppose that the glacier did not scoop out the lake bed, but simply smoothed its surfaces, it follows that there would be a glacier of from 3000 to 4000 feet in action. Now, can it be conceived that this vast mass slid over the bed of the present lake for a geological era, without working its bed deeper and deeper?

We find, on examining the beds of such rivers as the Kawarau and Shotover, that running water, probably never even in the highest floods more than forty feet deep, can cut or wear channels through hard schist rock, of 200 and 300 feet deep. If running water, and the sand and gravel which it carries along, can produce such effect, it seems easy to arrive at the inference that a glacier, say 1000 feet thick, would, with chips of rock adhering to its under surface, plane down its bed to a depth only limited by the duration of the process.

---

* See Art. XLIX.

The turbid water issuing from glaciers is an evidence of their degrading power. The waters of the Dart and Matukituki—both glacial-fed rivers—are of a milky colour. Dr. Hochstetter, in his *New Zealand*, states that the Tekapo Lake is always turbid, from the fact of its supply coming from one of the great glaciers of Mount Cook. Forbes explains that this turbid appearance, constantly the same from age to age, is due to the impalpably fine flour of rocks ground in the ponderous mill betwixt rock and ice.

It may elucidate the subject if we suppose the formation of a lake basin about to begin. Let a glacier descend a mountain slope to a valley, then it must either penetrate through the floor of the valley on the line of the mountain slope, or, in its endeavour to do so, be either bent or broken to the slope of the valley. But this effort of the glacier to continue in its initial slope, must necessarily cause great friction, and where there is friction, there must also be degradation of surface. The friction due to a change from a greater to a less slope is in excess of what may be termed the sliding friction, arising simply from the motion of the glacier over a uniform slope. Thus, at the points of greatest friction, there will be a scooping-out process at work. Nor is this an intermittent operation, but will continue as long as the glacier exists. As the process proceeds, the part of the valley first operated on will have been scooped out, and the valley slope assimilated in part to the mountain slope. The condition of excessive friction due to difference of slope will then apply to a more advanced part of the valley, and so on, till temperature arrests the process by melting the ice.

According to this view of the subject, we ought, keeping all modifying causes out of sight, to find that the lake bottoms are a succession of slopes, steepest next the glacier mountains, and gradually less and less as we proceed from them. The bottom of the Wakatipu Lake complies with these conditions. Taking the soundings from the map in the Otago Museum,* and interpolating the soundings taken off Collins Bay, there will result for the first two miles from the head of the lake a fall of 180 feet per mile, for the next four miles a fall of 70 feet per mile, for the next five miles a fall of 50 feet per mile, for the next seven miles a fall of 40 feet per mile, for the next six miles a fall of 6 feet per mile, for the next six miles a fall of 14 feet per mile, for the next three miles a fall of 30 feet per mile, for the next seven miles a rise of 16 feet per mile, for the next nine miles a rise of 96 feet per mile.

It must be mentioned that the slope of 180 feet per mile for the first two miles may be considered greater than the true glacier or lake bottom, on account of the river deposits of the Dart and Rees.

In regard to the ascending slope of the lake bottom for the last sixteen

* Map showing Surface Features of N.W. District of Otago, by Dr. Hector, 1864. Partly reduced, and accompanied by a Section to elucidate this subject, in Plate 1a, *Trans. N. Z. Inst.*, Vol. ii.

miles, of which seven miles are at 16 feet per mile, and the last nine miles at 96 feet per mile, it accords with the gradual recession of the glacier, and the deposit of moraines in the same order. It must also be noted that as the glacier retired, more and more of the lake bottom from the south end would be released from the grinding action, while the operation would still be in force in the other parts of the lake.

As already mentioned, there are no soundings of the other lakes available in this investigation. But the very complete Admiralty survey of the West Coast affords a comparison with each of the sounds there. In all of them there is this peculiarity—that, while they are from 700 feet to upwards of 1200 feet deep, in no case is their entrance to the ocean deeper than 350 feet —so that if the West Coast were raised 300 or 350 feet, the sounds would become lakes varying in depth from 400 feet to 900 feet.

If glacial action is sufficient to have excavated the sounds on the West Coast, it may be urged in objection—Why should the glaciers scoop out deeper basins in the hard rock of the West Coast, than in the comparatively less hard rock of the Wakatipu Basin?

This objection might be disposed of by assuming that the West Coast has been gradually sinking. But adhering to the mechanical principle, the objection may be met by considering that the slopes on the western side of the mountains are more steep than on the eastern side, and therefore the glaciers would act more efficiently, having a greater vertical longitudinal pressure, and by the same difference a greater friction. Then in regard to the harder rock. This objection would be of great moment if the ice were the rubbing power; but it is only the frame or machine in which the chips of rock are set to do the grooving. In hard rock these chips will be part of the rock itself, so that the difference as to the nature of the rock is not so great an objection as at first appears.

The difference in the depth of the sounds seems to have a relation to the heights of the surrounding mountains, as though the excavating process was most active where the greatest snow field existed to feed the glacier, and the greatest pressure to urge it forward. The lake at Martin's Bay [Lake McKerrow] is the only lake of any note on the west side. It may be cited as an illustration of the excavation or basin bearing a relation to the efficiency of the glacial action. The Hollyford Valley, in which this glacier would lie, is the largest valley on the west side of Otago. It is surrounded by very high mountains, which would create and maintain a large glacier. Under these conditions, not only has a basin been excavated, but sufficient moraine matter has been carried forward to dam back the sea, and so a lake has been formed, and not a sound

In a paper by Dr. Hector,* in *Trans. N. Z. Institute*, Vol. ii., pp. 373-4,

* The author appears to hold the view, now generally abandoned, that the motion of the lower and horizontal part of a glacier is due to *vis a tergo*. In other respects he

reference is made to the excavating power of glaciers; but, while acknowledging their efficiency in this respect, the lake basins and sounds of the West Coast are referred to subsidence of the earth's crust. He states:—"This subsidence has been most rapid in the central and western part of the range, so that in the case of a long valley, like that occupied by the Wakatipu Lake, the slope bacame gradually reversed, and what was at first the higher part of a glacier-excavated valley, has become a depression without an outlet."

The meaning of this seems to be that the depression was subsequent to the glacial excavation of the valley. To realize the condition of the valley at the close of the glacier action, it will be necessary to conceive the bottom of the lake basin lifted up, so that the valley would throughout its entire length slope in the one direction. Applying this to the Wanaka Lake, the bottom at the south end would come near the present level of the lake surface, 974 feet. The height of the saddle at the head of the Makarora Valley is given by Dr. Haast at 1716 feet, and the distance between the two points is about fifty miles. The fall is therefore 742 feet, or say 800 feet, or a mean slope of 16 feet per mile. But the slope would not be uniform, and so be less over a part of the valley. Forbes states that the slope of the glaciers in the Alps is seldom or never under 3 degrees, or 276 feet per mile. He says, however, that the glaciers which transported the blocks of granite from Mont Blanc to the slopes of Jura would not have had a greater mean slope than 1·8 degrees, or 104 feet per mile, and the slope of a great part of its course must have been much less. Reasoning from the semi-fluid nature of a glacier, he does not pretend to fix the limit of mean slope, and he says it might even be as little as 15 min., or 23 feet per mile. From this it will appear that we cannot assume that a glacier would not move with a mean slope so gentle as even 16 feet per mile. But if we are to accept the subsidence theory, it will be legitimate to apply it in such a manner as will best dispose of the objections that may be urged against it. If we, therefore, conceive the subsidence to have taken place before, and not after, the glacial period, the mean slope of the Wanaka glacier would be greatly increased, and so be brought nearer the ascertained facts of glacier motion.

When the great glaciers occupied the valleys and lake beds, the climate must have been much colder than it is at present. The causes of change may have been various. When we contemplate the vast accumulations of denuded material which is now in the valleys, it is evident that the mountains must have been more massive and probably higher before the denudation began. There would therefore be more surface above the snow line, and by the same proportion, greater snow fields and greater cold. But this is inadequate to the

---

adopts the arguments and conclusions of the paper cited, but without fully appreciating their bearing on the question.—Ed.

effect, unless we conceive the present mountain system to have been a great table-land. We are precluded from this supposition, however, by the fact that the high angle at which the rocks lie, determines that from the first upheaval of the mountains there must have been elevation and depression, ridge and valley, as at present. And the denuded material already mentioned has resulted from the widening and deepening of the valleys by glacier and river actions. If we look to the disparity of climate between Labrador and North-western Europe, on the same lines of latitude, and resulting from oceanic currents, there can, by analogy, be no difficulty in supposing such a distribution of land and water in these latitudes as would make a south polar current sweep along the shores of this island, and chill its temperature to the required degree. The equatorial rains, which now nourish the great forests of the western and lake districts, would then descend in snow, and the glaciers would reach their furthest limit. It is remarkable how near our latitude, even at the present time, approaches in locality to the glacial period. At Dunedin we are only about 1600 miles from the ice precipices of the Antarctic continent, and the glaciers are said to descend nearly to the sea in the Straits of Magellan.

The glaciers of Otago have not yet been sufficiently explored to ascertain the lowest level of their terminal faces; but it may be stated that some of the secondary glaciers on Mount Aspiring are from 4000 feet to 5000 feet above sea level.* In sheltered situations, some of them will, no doubt, be lower than this. Dr. Haast gives the terminal face of the Tasman Glacier (Mount Cook) at 2774 feet. Forbes gives the terminal face of the Mer de Glace (Mont Blanc) at 3667 feet above sea level.

The snow line in Otago is from 7000 feet to 8000 feet above sea level. There is a considerable extent of country above this line, the principal part lying between Earnslaw, 9165 feet, and Mount Aspiring, 9949 feet. The intervening ranges of the Forbes and Humboldt Mountains are covered in all their high parts and ravines with snow fields and glaciers. In a bright sunshine they are so dazzling that it is only with an effort that the eye can rest on them. From the melting of these great snow and ice fields, the Dart, Rees, and Matukituki have their waters. The Makarora and Hunter similarly flow from the glaciers in Canterbury. As the supply of these rivers depends almost entirely on the melting of snow and ice, their volume is regulated by temperature. This gives rise to a set of conditions very much the reverse of what obtains with rain-fed rivers. In winter the glacial-fed rivers are very low, especially during frost, while in summer they are high. On a warm summer day, the difference of their volume between morning and evening is very apparent.

* The largest glacier from the west side of Mount Aspiring descends to 1400 feet above the sea, and the Francis Joseph glacier, from Mount Cook, to within 700 feet.—Ed.

The north-west wind, especially if accompanied with a warm drizzling rain, has a very marked effect on this class of rivers. At such times, the Dart, Matukituki, and such like, become rivers of half a mile wide, and of course pour into the lakes vast quantities of water. The valleys on the west side of Te Anau and Manipori Lakes being generally very narrow, the vertical rise and fall of their rivers is quite astonishing. In many of them, unmistakable flood-marks show that this is not less than 20 feet. The actual observation of these facts impresses the mind very forcibly with the value of the lakes as great regulating reservoirs for the Clutha and Waiau Rivers. The Clutha has 237 square miles of lake to regulate its flow, and the Waiau 198 square miles, or, altogether, an area of 435 square miles for the two rivers. This surface, like a great compensating balance, is ever in a state of oscillation up and down between the inflow and outflow of the rivers. But it attains its maximum level for the year in January or February, and its minimum in July or August. The vertical range of lake surface varies in different years, and the lakes have also differences depending on their area and supply. Generally, the range may be stated at from four to nine feet.

In the season of 1865–66, the Wakatipu Lake had a range of no less than ten feet. On the 14th January it attained its highest level, the water standing two feet deep in Rees-street, Queenstown. The lake had probably not been at so high a level for a very long time before, for trees of two and three feet in diameter were sapped by the rising waters, and laid prostrate on the margin of the lake. A cold spring preceded this great flood, and the lake was then nine inches lower than it has ever been known to be before or since. Consequent on this coldness, more snow than usual was reserved for the melting of the summer sun. The lake had reached a high level, when three days of warm wind from the north and north-west, accompanied with rain, raised its surface to the highest observed level.

The fact of the lowest and highest levels occurring in the spring and summer of the same season, and so intimately connected with change of temperature, is an evidence of the value of our equable insular climate in the river system of the country. For with the same temperature, but colder in winter and warmer in summer, the glacial-fed rivers would become still more fluctuating; and such rivers as the Mataura and Taieri, that have their principal sources in high snow-clad mountains, and have no lakes worth mention to regulate their flow, would necessarily become much more irregular in volume than they are under present conditions.

The ordinary condition of a glacial river, such as the Dart, is a rapid stream of three or four chains wide, and from three to four feet deep, with a number of smaller branches running out and into each other as they continue their course along the channel, which is a wide waste of shingle and quicksand, at places a mile broad. This matter is carried forward to the lakes, and by

the delta so formed the channels of the rivers are all advancing into the lakes. This progress is necessarily very slow, from the great depth which has to be filled up. But the amount of matter so deposited is conclusive evidence of the many ages during which the present geographical order of river and lake must have existed. This silting action has gone on principally at the northern ends of the lakes, where invariably a large river enters. The lakes have each in this way been filled up for several miles. The smaller rivers which enter at the sides of the lakes are also encroaching. Thus the Dingle has formed its delta more than half way across the original breadth of Hawea Lake. The continuation of the process, together with the deposits of the Hunter River, will, in time, reclaim several miles of the lake.

The lessening of the lake areas is also promoted by the eroding action of the rivers issuing from them. The high terraces surrounding them show that their surfaces must have been considerably higher at one time. A minor triangulation has been extended over the middle and upper part of Lake Wakatipu. It determines that the terraces at Greenstone, White Point, and Frankton, are each 100 feet above the present level of the lake. There are other terraces, the heights of which have not yet been ascertained. In the accurate determination of the heights of terraces above the present lake level, there is, apart from finding the ancient lake levels, the means of detecting any secular variation of level that may have taken place in the island since the lake system began. If, for instance, the west side of the island is sinking and the east side rising, the old contour marks or terraces of the lake will not be parallel to its present surface. The detection of this difference, supposing the variation to have taken place, would no doubt be a delicate operation if the oscillation has been insignificant. If, on the other hand, the oscillation has been considerable, it could not fail of detection.* There are several other questions concerning Lake Wakatipu which the extension of the trigonometrical survey will throw light upon; there is the abandoned river bed at Kingston, and there is the supposed leakage of part of the lake waters through the Kingston Moraine to the Mataura River.

From the twofold influence of silting up and erosion, it is plain that the tendency is to transform each lake into a valley, with a river running through it. This process has been already completed on a small scale in some of the higher valleys. A moraine has, in the first place, dammed across the valley, and then the lakes so formed have been silted up, and are now a succession of flats, with a river running through them, and rushing over the moraines as a rapid. In the higher valleys there are also, in some places, masses of rock lying confusedly across the valley, that at first sight appear to be moraines, but

* The terraces are due to alterations in the level of the outfall of the lake, and could not be affected by such oscillation.—Ed.

in reality are the fragments of great rock slips that have been hurled, by the action of frost, from the adjacent mountain steep.

It is difficult to realise, without actual observation, the activity of the disintegrating forces, and the vast amount of matter that the mountains are denuded of even in the course of one year. The phrase "everlasting hills" is really a misnomer, for the forces now unceasingly at work will level the highest mountains and fill up the deepest lakes. Frost is the great disintegrator. The melting of the snows, and the moisture from the clouds, penetrate the rocks during the day; the freezing at night splits them, and the result is long streams of angular fragments from the peaks, and talus heaps around the bases of the precipices. In the higher snow fields, the avalanche, with the noise of thunder, hurls its snow and ice masses into the valley below—there to be kneaded into a glacier, or to rush on as a torrent or succession of cascades. The traveller, in making his first acquaintance with such mountains as the Southern Alps, is apt to be more or less bewildered and appalled with the din and potency of forces at work, and with the vast dimensions of the surrounding scene.

The climate of the Lake District, as indeed the whole of the island, is determined by the Southern Alps. They lie directly athwart the track of the equatorial winds, and their cool tops condense the vapours with which these winds are so highly charged, and hence the almost tropical rains of the West Coast. These high mountains so effectively drain the winds, that there is comparatively little left for the interior of the country, and but for the secondary ranges, such as the Dunstan and Hawkdun Mountains, conserving what does fall in the form of snow, the interior plains and valleys, not on the banks of lake-fed rivers, would for a portion of each year be waterless.

Although the Otago portion of the Southern Alps is from 6000 to 10,000 feet high, yet there are numerous saddles in them much lower, from which the valleys run to the West Coast on the one side, and to the lakes on the other. The valleys on the lakes' sides act as funnels, down which the winds blow and discharge their moisture. The effect of the discharge is seen in the forests which are invariably found in these valleys. In several cases, where the saddle of the dividing range does not exceed 3500 feet above sea level, the forest is continuous from the west to the east side of the mountains. Thus, beginning at Martin's Bay and following up the Hollyford Valley to the Eglinton Pass, thence to the Te Anau Lake, and then down the Waiau Valley to the ocean, there is a continuous belt of forest, 160 miles in length, and, with its ramifications, covering upwards of a thousand square miles. It is worthy of remark, that the forests of Otago are all to be found within the districts enjoying a moist climate. Thus, on the west side of the province there is the country between the West Coast and the lakes; on the east side there is the margin of 30 or 35 miles along the coast over which the south-westers usually

extend. The highest ascertained limit above sea level of the forest is 3500 feet.

The comparatively dry interior districts, extending principally between the Clutha and Waitaki Rivers, have no forests. There have been, however, forests in the interior districts at one time, for the charred trunks of trees are still found on the Rock and Pillar Range, and on the Waitaki side of the Kurow Mountains. In the Lake Districts, similar evidence of a greater extension of forest is also found. The apparent cause of the annihilation has been fire, but it is quite probable that natural causes may also have operated.

If we examine any of the forests on the East Coast in their natural state, and before a litter of rejected timber and branches has accumulated in them, it seems difficult to imagine that a fire could make its way through them. But the forests in the Lake Districts, and generally in high altitudes, are free from the tangled undergrowth of the East Coast forests. In place of it the soil has a covering of foggage and moss, often a foot deep. In a dry season this readily ignites, and as it smoulders rathers than burns, the work of destruction is very sure over the surface the fire extends. In this way a portion of the forest in the Te Anau District was destroyed some years ago by a grass fire kindling the foggage.

The Maoris frequently traversed the forests of the Lake Districts in their hunting excursions, and no doubt their fires would cause the destruction of parts of the forest from time to time.

Speaking of the Lake Districts in a general manner, it may be observed that, considering the extent of agricultural, pastoral, and forest land that abounds in them, their mineral products, their delightful climate, and extent of inland navigation, they have within their own borders all the main elements that render communities prosperous and flourishing.

Art. XLVIII.—*On the Sand Hills, or Dunes, in the neighbourhood of Dunedin.* By P. Thomson.

[*Read before the Otago Institute, May* 31, 1870.]

These sub-aerial formations in this vicinity are very extensive, and present a series of phenomena of a very interesting character. It is not the intention of the writer to go very deeply into the causes of these phenomena, but to give a few rambling notes descriptive of the present appearances of the dunes, which may perhaps serve as data for future observations. These may be divided into three heads :—first, their locality; second, their extent; and third, the rate at which they are progressing, if it can be made out.

Beginning with those to the south, beyond Green Island, we find that at the Brighton end of the beach, where the schistose rocks crop out above the

surface and run out into the sea, giving some very curious examples of wave action, the line of sand is very thin, the grass approaching, here and there, quite close to high-water mark. As we proceed northward, the sand gradually widens, forming a long flat or slightly undulating expanse, of about a quarter of a mile in width, with a line of low hillocks on the inner side. At the mouth of the Kaikorai River, there is a curions shifting bar, which is driven upwards by the force of the surf in fine weather when the river is low, and then, when the water inside has acquired volume enough, it washes away the sand, and scoops out a deep channel, which remains until the water has all run off, when the surf commences to re-form the bar.

North of the Kaikorai the beach assumes a slightly different character—the line of sand hills becomes more regular, and from the mouth of the lagoon gradually approaches the beach, until, about half way from the rocks at Green Island, the line of hills is the same as high-water mark. Along this part of the beach the hills present a bold irregular front, rising at a very sharp grade to a height of from thirty to forty feet. Inside this line the surface is very irregular, and is worn by the action of the wind into the most fantastically shaped hills and hollows. Here and there the hollows are deep enough to show the original clay bottom, and some of them usually contain small lodges of fresh water, the drainage of the surrounding hummocks. Crossing direct through the sand to the fields on the inner side—and a most fatiguing walk it is—a pretty good idea is got of the depth of the formation, as well as of the general direction of its motion, for the sand is found encroaching on the grass in many places ; and as we get nearer Green Island Bush, the trees are being gradually covered from sight. Indeed, on going down again from the district road towards the beach, through the bush, the rate at which the sand is invading the land becomes painfully evident. Large numbers of trees and bushes are completely buried, and the contrast between the dazzling white sand and the dark green of the vegetation is remarkable. Trees do not seem to live very long after they are covered to any depth by the sand, and in this way a sort of gauge is got by which to estimate the progress inland of the sand bank. After a broadleaf (Pukatea—*Griselinia littoralis*) has been buried to a depth of five or six feet from the ground, it begins to decay, so that in a season or two the tree dies, and the branches protruding above the sand become quite brittle and dry. From a repeated examination, the writer thinks that the sand is advancing into the thick scrubby bush in this quarter about ten or twelve feet a year. From this point northward, there is properly no beach, the coast line being occupied by a series of high cliffs, and it is not until we approach Dunedin that the sand becomes again the boundary between land and water. This part of the coast, however, is so well known that nothing need be said about it, so we will at once pass on to Lawyer's Head and Tomahawk.

Lawyer's Head is a low spur, running from the hills at the back of Anderson's Bay out to sea a short way, and is composed of a hard black basaltic rock at the bottom, and a softish reddish-coloured rock at the top. Before leaving Lawyer's Head, however, it is worth while observing that there is no such accumulation of sand here as there is at the corresponding end of Green Island beach. The cause is not difficult to find. The south side of the Head is a long gentle slope, offering little resistance to the wind, which sweeps up with great force at times, ranging the sand in long irregular ridges parallel to its course, and carrying a great proportion over the Head to the other side, where it lies in a steep bank against the precipice, accumulating, until it is carried off by the first high tide, and distributed over the rest of the beach. The phenomena presented on Tomahawk Beach are very much the same as those already described. The sand is gradually travelling northwards, and covering all the space between the lagoon and the ocean, rising over the low hill in the middle of the beach, and even finding its way into the lower part of the Tomahawk Valley. From this part northward, the coast line is composed for a long distance of a line of high shelving cliffs, running up to a height of 700 or 800 feet, and no sand is met with until the Sandfly Bay District is reached, where a line of sand hills bounds the beach. At the extremity of this beach stands that very singular feature in the scenery of the district—Sandymount—which is partly covered with patches of moving sand, but as the writer has never had an opportunity of travelling over this part of the coast, he will reserve his remarks on Sandymount until he has done so.

North of Sandymount lies that very beautiful locality, Hooper's Inlet, which possesses, in common with all the harbours on this coast the writer has seen, the fact of having on the right or starboard side, as you run in, a sand bank or spit; on the left, or port side, rocks, more or less high. Oamaru, Kakanui, Waikouaiti, Blueskin, Purakanui, Otago, Papanui, all present the same appearance as Hooper's on entering. In a strong south-wester, the writer has seen the sand flying from the shoulders of Sandymount in thick clouds, which are deposited on the beach at the entrance to the Inlet. The line of sand hills continues here for about a mile, when the bold promontory of Cape Saunders is met with. Of course there is no sand there, the coast being again a line of perpendicular rocks all the way round the forest-covered Mount Charles, to the entrance of Papanui Inlet. About a mile and a half from the ocean, at Hooper's, however, the distance between the two inlets is less than half a mile from high-water mark to high-water mark. Taking our way across this neck, and then across the wet flat of Papanui, of course at low tide, it is easy to arrive at the sand banks on the Wickliffe Bay side.

Proceeding towards the ocean, we find two distinct series of dunes, one of a much older date than the other, covered with green turf, while the one nearest the sea is only the usual loose drifting sand. The beach at Wickliffe

Bay is about two miles in length, a line of sand hills running all the way. Though composed of such loose material as dry sand, these hills maintain a character of permanence which is wonderful. For instance, when people were working at the wreck of the "Victory," steamer, about seven years ago, a sort of telegraph was erected on the top of one of the hills, which retains its contour and elevation very much the same to this day; and anyone looking at the long line of hills which mark the ocean beach near Dunedin, must have remarked how permanent they are, very little, if any, change having occurred in their general appearance for many years.

At the north end of Wickliffe Bay there is a high perpendicular precipice, and the coast continues rock-bound for a considerable distance, there being only two small bays with sandy beaches all the way to Taiaroa Head, at the entrance to Otago Harbour. Neither of these bays presents any peculiar feature, so we will at once proceed to the great accumulation at the Maori Kaik. This sand bank is by far the largest in the district, extending in a north-easterly direction from the rock at Korako's house for about two miles, while its breadth from tide mark is more than one mile. All the characteristic features of sub-aerial formation are here to be met with—long parallel ridges, smooth flats, high hummocks, and gently sloping surfaces. Even that rare phenomenon, musical sand, is occasionally present. In dry calm weather, at certain spots, when crossing the sand, a peculiar sound is occasioned by the feet in walking, a sort of "weef, weef," as if the sand were being struck by something sharp. In general, however, the sand only emits the usual crunching sound. Some portions of the surface of this bank are quite hard, and easily walked over; but, as a rule, the sand is very soft, and walking over it is a very fatiguing matter. From about high-water mark the sand slopes upwards, at first rather steeply, and then at a more gentle grade for a long way, the only break to the uniformity being that here and there stands a small hillock, on the sides of which grow a few straggling plants of a coarse hard grass, the roots of which serve to maintain the form of the hillock, in spite of the efforts of the wind to carry it away. The tendency of the sand here is upward, and to the north and east. At times, during a strong southerly storm, the writer has seen the sand raised in thick clouds, and carried onward in tons, and spread over the grass and among the trees at the upper edge, where it lies, never to go back, but to be covered over by another layer by the next storm. In this way the bank has attained its present huge dimensions, and will, sooner or later, reach across the hill and over the declivity to the outer beach. The rate at which this is going on is surprising. On one occasion, after one of these gales, a long stretch of grass, some 70 or 80 yards wide, by 250 or 300 long, was covered by the sand, just as snow would have done, but with this difference, that whereas the snow would have disappeared with the next day's sun, the sand remains, and the land is rendered totally barren.

The depth of this sand bank varies considerably, according to the inequality of the surface of the land underneath. Near the middle, where it has crossed a gully, it is probably 40 or 50 feet deep. At the northern edge, where it approaches the hills, it has at one part formed a very beautiful bank or slope, of from 30 to 60 feet in depth, the grade being very steep, so much so that one would hardly think that so incoherent a material as dry sand would maintain such an acute angle. Standing on the edge, and pushing away the sand with the foot, it falls over and over in small waves until it reaches the bottom, just like so much water, only not quite so fast. The opposite hill is very steep and rocky, so that when the sand has filled up this hollow, its further progress in this direction will be checked. Further east, however, the hill is much lower, the slope more gradual, and the sand is steadily advancing up the incline. A few of the Maori houses located on the flat land above will have to be removed, or they will be encompassed by the flood of sand, and the lives of the inmates rendered very miserable.

Hitherto we have seen the sand travelling in an easterly or northerly direction; let us now turn to another part of this same beach, and we will find the prevailing motion exactly the reverse. On the other side of Korako's house is a little flat, where the old settlement of Otago stood. The buildings have long since disappeared; indeed, a pretty broad slice of land on which they stood has been washed away by the sea, and what was once a pretty green flat, with a few old ngaio trees on it, is now a sandy waste. A little further on, Harwood's house stands on the beach, and a short way in was a fine garden, with fruit trees and bushes in plenty. But the sand has put horticulture to flight, and the garden is now reduced to very small dimensions; the tops of the bushes may be seen sticking up through the sand. If it goes on as it has been doing, a very short interval will elapse ere the whole flat will become as barren as the beach below.

Proceeding now to the other side of the harbour, we find an extensive flat or spit, nearly covered at each spring tide. The sand does not seem to accumulate here, for the spit lies freely exposed to the wind, both out and in; what the north-easter blows on is just blown off again by the south-wester, and in this way a sort of uniformity is maintained. A little way round the corner, however, towards Hayward's Point, the sand assumes a shape which merits a word or two in passing. The beach here is hemmed in by perpendicular rocks, rising some 200 or 300 feet above the tide. Standing near the water, and looking upward, the sand seems to lie against the rocks. But this is not so; for on getting up to the top of the bank, a most singular fact is discovered. Instead of the sand covering the base of the precipice, there is a long narrow valley, with numerous trees and bushes growing luxuriantly in it; the sand, which slopes gently up from the beach, ending all at once in a steep declivity.

To the westward of Hayward's Point there are three beaches, divided from each other by precipitous bluffs jutting into the sea, viz., Kaikai, Murdering, and Long, all of which were formerly occupied by a numerous Maori population, now quite extinct. Beyond Long Beach, the coast at Purakanui is very bold, continuing so till Blueskin is reached, where there is a sandy beach and spit of considerable extent. Northwards, for a great many miles, the coast is again rock-bound; and it is not until Waikouaiti Bay is reached that much sand is found. Northward of this bay the beaches are mostly composed of a hard shingle or gravel, more or less fine.

I have thus, in a very brief way I must admit, gone over and described the leading features of all these beaches. Two questions now occur for consideration, viz.:—Where has all the sand come from? and, How long has it taken to accumulate? In reply to the first, the writer ventures to propose the following hypothesis:—Away down the coast two large rivers run into the sea—the Clutha and the Taieri—both conveying large quantities of sand and other detritus to the ocean. Now, some of this, no doubt, is deposited close to the mouths of these streams, but a considerable portion must be carried off far enough to be taken up by the constant northward current which sets up the coast, and deposited gradually as it goes on, getting again driven up on the beaches by the tides and the surf. There is also, as a contributory cause, a long line of soft sandstone cliffs between Green Island and the Forbury, the material of which is very easily weathered and very rapidly acted on by the surf, which carries off large quantities every storm. On looking down on the sea from the top of the cliff, the discoloured water can be seen quite distinctly travelling northward. Now, at Lawyer's Head, the water is all clear again, or at least it is all one shade, so that some of the sand must have been deposited to form the dunes on the Ocean Beach and on the Tomahawk. A large portion is no doubt carried on, some to be brought up by Cape Saunders and deposited about the Sandfly and its vicinity—some to be carried past and dropped about Wickliffe Bay; but a large portion will still be in suspension and be carried into the various inlets, including Otago Harbour, with the tide, and then, whenever slack-water occurs, it will fall to the bottom, to be worked up to the beach, and eventually blown ashore to form those large accumulations which are now to be seen all round. Still, it is hard to believe, taking the big bank at the Heads for an example, that this huge quantity of sand can have been blown off such a narrow strip of beach as there is there, nowhere more than three hundred yards wide. And yet off that beach it comes, as may be seen almost any fine day when there is a little wind blowing. Very shortly after the tide has left the flats, the wind begins to lift forward small quantities of the sand, and they blow on and on until they reach the bank, there to remain.

The time these formations have taken to assume their present dimensions

is not so easy to ascertain. Indeed, the whole phenomena seem to point to a slow raising of the land round our coasts. Old Maoris say that the Ocean Beach was once a shoal, and that the tides met. Indeed, there is one point of the Ocean Beach where it is not an unlikely thing that an extra high tide, accompanied by a heavy sea, would work a channel through to the St. Kilda flat inside. The hills are neither wide nor high, and there is very often a large shallow sheet of water left by the tide. But then all over the St. Kilda flat the ground is full of the trunks of big trees, which must have grown on the spot. To reconcile these two, there must have been a lowering and then a raising.* At the Heads, when the first settlers came, the sand bank was much less in extent than at present. In front of Kelvin Grove there was a pretty large lagoon, frequented by ducks and other fowl, not a vestige of which remains. A number of natives used to live around the bottom of the bay; they have long been driven off to the higher ground, and from this in turn they seem likely to be driven still further off by the sand flood which is slowly but surely advancing towards their clearings on the further side of the hill. It is about eight years since the writer first traversed this particular bank, and in that time it has grown considerably, both in length and breadth, and depth. This part of the subject is one of very considerable difficulty, and the writer must leave its further consideration in the meantime, trusting that wiser heads than his own may give the matter some attention, with a view to the elucidation of the almost paradoxical phenomena which are presented by the sand dunes around Dunedin.

When rambling about among the sand hills one day, my attention was directed to some very curious stones which were lying about in one of the permanent hollows. I collected a few samples, and showed them to various people, but to all they were quite a puzzle, though opinion evidently inclined to the belief that they were artificial. I was very agreeably surprised, on looking over the new volume of the *Transactions*,† to find that similar stones had been found near Wellington, and described and figured in the volume. I lay a few specimens on the table for the inspection of the members to give them a better idea of what they are like.

---

* This undoubtedly was the case, as round the coast of New Zealand the evidence of a 25-ft. raised beach is distinct, prior to the formation of which submergence prevailed. —Ed.

† *Transactions of the New Zealand Institute*, Vol. ii., Art. LXII.,—"On the Sand-worn Stones of Evans' Bay," by W. T. L. Travers, F.L.S.

Art. XLIX.—*On the Disposition of Alluvial Deposits on the Otago Gold Fields.*

By L. O. Beal.

[*Read before the Otago Institute, April* 12, 1870.]

The remarks I am about to make I crave indulgence for, as I can lay no claim to scientific attainments, and my experience of the appearance and physical construction of the country has only been gathered during some four hurried business journeys of about ten days each, being in fact little more than could be gathered by an ordinary coach traveller from Dunedin to Queenstown and Skippers, a distance of about 200 miles.

The question I am about to discuss, embraces the terrace formation of our inland plains or basins, such as are observable in those of the Maniototo, Dunstan, Cromwell, and Queenstown; also, the question of deposits of gold in old river beds, which we commonly term deep leads. The first of these basins—the Maniototo—is reached by proceeding up the Shag Valley, over a saddle in the spurs of the Kakaunui mountains, *via* Pigroot. I do not allude to the terrace formations in the Shag Valley, except to state my belief that they have the same nature as the rest. The line of elevation also at which the coaches travel up this valley is not favourable for noting these features. In descending the saddle from Pigroot into the Maniototo Plains, our view embraces the Rock and Pillar Range, lying slightly to the left; the Kakaunuis, over which we pass, extend to the right, till they reach the Mount Ida Range, succeeded by the Little Ida, Hawkdun, St. Bathans, and Dunstan Ranges, which are at about right angles, and extend along our route up country, and form an arch or bow-like right hand boundary as far as the Dunstan township. From the Rock and Pillar, on the left, at some distance a-head, the Rough Ridge shoots out across our path, and may be said to join the right hand ranges at the Little Ida, and thus form the Maniototo Plains. Passing over the Rough Ridge, at a low elevation, our road crosses the Ida Valley, the extreme left of which is under the Pinelheugh Range, Raggedy and Blackstone Hill Ranges, crossing our road from the left in the same manner as the Rough Ridge, and joining the right hand range at about the junction of the Hawkdun and St. Bathans Ranges.

Passing out through Blackstone Hill we enter the Manuherikia Valley, the left hand boundary being the Blackstone Hill and Raggedy Ranges as far as the township of Manuherikia. At this point we meet the Molyneux River, which here flows across the valley for about seven miles from the Dunstan township, where it enters through a gorge, about thirteen miles long, which it traverses from the Cromwell Basin. The Manuherikia Valley (across the river) is bounded by the Carrick and Old Man Ranges, and a few spurs of no considerable elevation, in which are Conroy's and Butcher's Gullies.

The drainage of the Maniototo Plains is effected by the Taieri River, which takes its rise in the Lammerlaw Range, entering the plains between the Rough Ridge and the Rock and Pillar, which it skirts, and finds an outlet under the same range, at another point between that and the spurs of the Kakaunuis, to the left of the saddle over which we are presumed to have journeyed. This river is fed by the Swine and other burns flowing from the ranges on the right hand, and by the Kyeburn—which takes its rise at the mount of that name, in the neighbourhood of the Maruwhenua Pass, flowing along the foot of the Kakaunui—and joining the Taieri River in the neighbourhood of the Taieri Lake. The land under Mount Ida, and at the township of that name, would thus appear the highest in that district, and higher than the Ida and Manuherikia Valleys. The Ida Valley is drained by the Ida Burn, which takes its rise on the right hand, and the Pool Burn on the left; these two join together at a gorge in the Raggedy Range, and flow through it in one stream into the Manuherikia Valley, and river of that name, which at the township of the same name, joins the Molyneux River, and then passes through a gorge down through the Teviot Basin. The Ida Valley is also drained on the extreme left hand by the Manor Burn, which takes its rise between Pinelbeugh Range and Rough Ridge, and also joins the River Manuherikia. The Ida Valley is thus higher than the Manuherikia Valley. The Manuherikia Valley is drained by the river of that name, and by the Lauder, Chatto, and Dunstan Creek tributaries.

In the Maniototo Basin, on the Rock and Pillar Range, there are alluvial diggings at Hyde, extending to no very great height above the water level, and at Hamilton, at an elevation of about 800 feet or higher, and Mount Ida, under the highest peak of the range of that name. Latterly, also, at the Kyeburn River, at about the junction of Mount Kakaunui and Mount Ida Ranges, in the vicinity of Mount Burster, not far from the Maruwhenua Gorge.

In the Ida Valley, the diggings are at the Welshman's and German Hill, one of these being in either face of Blackstone Hill and the Rough Ridge, at about the centre of the valley, and both at some elevation, say, at about 100 feet above the water level. I am informed there have also been some deep alluvial workings, to about 150 feet, under the Raggedy Ranges, at Black's No. 3, the lead running parallel with the ranges, and under a terrace formation. In the Manuherikia Valley, the diggings are at St. Bathans, Drybread, Black's No. 1, Manuherikia, Conroy's, Butcher's, the Fraser River, and Mutton Town Creek; the banks of the Manuherikia and Molyneux. The beaches or exposed portions of the bed of the latter river, during hard frosty weather, have been also extensively worked, with extremely rich results, especially where perseverance has been shown by the miners working below the water level, as at Frenchman's Point, at the junction of the Manuherikia and Molyneux Rivers. Extremely rich returns have been secured by the dredgers on the Molyneux

River, from the Hospital and Hartley and Riley's bars or beaches; these two places, in fact, may be likened to two ripples placed by nature in her sluice box, the Molyneux River, and there are, without doubt, many equally rich places. At the Dunstan township, the road enters the gorge, and continues by the river side to Cromwell; at the former place the banks are about 35 feet high, and at the latter 75 feet. The gorge is filled with immense water and ice-worn rocks and boulders, and at places on either bank a terrace formation is observable.

Our road to the Wakatipu, or Queenstown Basin, lies up the Kawarau River, which, at Cromwell, joins the River Molyneux in its course from the Wanaka Lake. After crossing the plain, and temporarily losing sight of the river, we again fall in with it on entering the Kawarau Gorge, through which we pass in company with it till we reach the Arrow District, at the lower end of the Queenstown Basin. The Arrow River, which takes its rise under Mount Hyde, flows into the Queenstown Basin, and merges into the Kawarau not far from the Arrow Bluff, and has here cut through the slate rock perpendicularly to a depth of about 200 feet. The Kawarau River is also fed in the Wakatipu Basin by the Shotover River, which takes its rise between Centaur Creek and Treble Cone. The Kawarau Gorge is filled with the same evidence of water and ice action as the Dunstan Gorge. It will be remembered, that till we reach the level of the Wakatipu Lake we have been steadily ascending, and in both the Cromwell and this basin, as we progress, we advance against walls of terraces that continually rise on the horizon to our view, and these on our return journey entirely disappear, or rather no such appearance is observable, from which circumstance I presume, that the weight of water pressing downwards has swept all before it, and prevented the formation of any such accumulations to form this terrace appearance, these terraces being composed entirely of drift.

In the Dunstan Basin the same thing is observable. Starting from the Manuherikia township towards the upper watershed of the valley at Dunstan Creek, terraces are seen under the Dunstan Ranges, but I believe no corresponding formation on the other or lower side, bounded by Blackstone Hill and the Raggedy Ranges.

I am informed that the features of the Arrow and Shotover Rivers are precisely similar. From Queenstown the road to Skipper's Creek does not continue directly up the gorge through which the Shotover River passes, but traverses a high saddle, and joins that river near its junction with the Moke Creek. On either side of this river are what are styled upper terraces, flat areas of land, having a scarcely perceptible inclination towards the river, so that where the gorge or valley widens, some considerable breadth of such land occurs, so much as nearly a quarter of a mile in depth at places. I have been as far up this river as Skipper's Creek, which, but for the small quantity of

water, might also have been styled a river, in so far as the characteristics of its watershed or valley are concerned; these upper terraces are conspicuous here, and I believe many other creeks exist having the same distinct features. The heights of the different ranges of the hills (and mountains as we style their highest peaks) forming these watersheds, of course vary, and their sides are also irregular, presenting many precipices almost perpendicular, and slopes of not very acute angles, showing, in fact, so much unevenness and so many fissures, that I will rather leave you to imagine than attempt to describe them, bearing in mind that in places such as at the Remarkables and Mount Aurum, the schist rock has been pushed up to elevations of some 6000 feet. The appearance to me was as though, when being thus forced up from below to its highest peaks, the strata, from insufficient strength, became broken, and the sides of what would have been an even plane from base to summit were shattered, presenting an appearance very like waves of the sea when driven before a gale, or the teeth of a common hand-saw; the sides of the sections nearest the points of upheaval being precipitous in the extreme, and the others presenting a more gradual slope. It will readily be conceived that many thousands of streams exist in a chain of such mountains, the accumulated power of which must be very great. It may also be conceded that these converge towards a few points as they discharge themselves into the sea in the shape of rivers. The ages of these rivers have, by clever and experienced men, been read, or it has been attempted at least, and definite periods assigned to their existence. Assuming that a a river, in cutting the rock, leaves its distinctive mark, what age shall we give to the Shotover, when we find that it has cut through the hard slate rock to the extent of about 200 feet? This same feature is also very plainly shown where the Arrow joins the Kawarau, and where both these rivers appear to have cut, perpendicularly, fully the same depth through a hard metamorphosed slate rock. The level of the Wakatipu Lake is 1000 feet above the sea; Cromwell, about 800 feet; Dunstan, about 600 feet; Teviot, about 400 feet; the Beaumont, about 150 feet.

Having now travelled to nearly the highest ground in the province, I have to make a hurried sketch of the country over which we have passed, skimming as it were in my return journey, over the tops of the hills and ranges, along the bases of which we have so far progressed; their heights vary from 7000 feet at Mount Aurum, to about 700 feet at the Coast Ranges. Mount Aurum, the ranges on either side of Skipper's Gully, and down the Shotover, till arriving at the Wakatipu Lake, present well-defined peaks, and the view from Queenstown embraces many such features; the Remarkable Peak affording a notable specimen. Another feature, however, is also here abundant. Hills and ranges of considerable elevation, say 1500 or 2000 feet, no longer retain those peaked or sharp featured characteristics, but are rounded off, and the sides ground down, smoothed and striated. This new feature I attribute to the

action of ice during what is called the glacial period. Proceeding down the Kawarau Gorge, through the lower end of the Cromwell Basin, to Dunstan and Manuherikia, almost all traces of the sharp peaked features are lost, rounded slopes being the most observable, with river cuttings and deep furrows scored in the sides of the Dunstan and Carrick Ranges. In continuation with a third feature, so distinctly marked as to have produced in the minds of the first explorers evidently a very strong effect, we find the various ranges at the lower side of the Dunstan, Ida Valley, and Maniototo Plains or Basins, called respectively the Raggedy Ranges, Blackstone Hill, Rough Ridge, and Rock and Pillar, the journey of about one and a-half days by the short road from the Manuherikia, nearly to the West Taieri, is, in fact, over almost a continual Raggedy or Rock and Pillar road, varied by creeks, gullies, and deep ravines, having anything but euphonious names conferred on them by the diggers,—the almost rounded hills being surmounted by rock, sometimes worn into the most fantastic shapes and life-like figures, till the Taieri is approached. The extraordinary features of this district may be judged of by the pictures in our Provincial Museum, and diagrams showing upper terraces of the Shotover, and the different features here alluded to.

The rough excrescences that led to the above names, are not so observable more immediately down the Molyneux Valley, as far as the Beaumont, where the road is no longer kept by the river side, and which point is about twelve miles from Tuapeka. This valley, the same as the Dunstan and Kawarau Gorges, bears ample evidence of ice action. From Tuapeka to the Woolshed, near Tokomairiro, for a short distance along the short road, the knobby appearance of the hills has entirely given way to smooth rounded hills, so that at the latter places the precipices and sharp peaks which we began with at Skipper's have entirely disappeared. I attribute these Raggedy and Knobby Ranges also to the action of ice, and regard these large fantastic masses of rocks as the parts of the peaks last left by the ice. The only occasional observable roughnesses I have examined on the latter rounded hills, consisted of large accumulations of cement, of different textures, colours, and components, which in places cover very considerable tracts of country; and I have found the same to a limited extent also on the Peninsula, in Dunedin Harbour, together with striated stones.

Down the Molyneux Valley are also to be seen very marked evidences of the action of water, to heights of fully 20 to 40 feet above the present level of the drift forming these valleys, on faces of rocks pointing up country—from which I imagine the flow of water during the glacial period, (when no material absorption by the earth could have taken place,) in warm seasons at least, very far exceeded that of the present day.

I must now proceed to notice this ice period, and try to realize its effects, and for this purpose ask you to remember the pictures that at different times

we have seen so well represented by our New Zealand artist, Mr. Gully, in his delineations of Mount Cook. The whole upper country is there represented as clothed with snow; and perhaps some of those present will remember its description by Drs. Hector and Haast, in the course of their explorations. I make these appeals to our own districts and residents, in order that, if possible, we may all realize the subject as of common and everyday interest. We will suppose that at some considerable height, on a range forming part of the watershed of a valley, we are travelling on this snow at night, when in the absence of the sun for some hours in such a bleak region, this may be done in safety: the crust of the snow will be of sufficient hardness to bear us, and but for the unevenness of the surface our journey might be performed in comparative comfort. As the day breaks, however, a change takes place: the snow, before crisp, will no longer bear our weight, a partial thaw setting in with the heat of the sun, we should sink in some places a few inches, in others one or two feet, and where the wind in drifting the snow would have almost bared high peaks and points of the rocks, the sun would melt the snow, and running water would be visible; the intense cold, however, of many feet of snow a few yards down the sides of the valleys would soon re-absorb the water, and the whole be turned to ice. Accumulations of snow would be made with the changes of the seasons, and these, in summer, would become partly rotten, or not of the solidity they were when first deposited, producing avalanches, which, in falling down, would of course, to a partial extent, displace small and large pieces of rock, which the frost would have acted upon and loosened; it will thus be seen that the valley gradually becomes filled with a mixture of snow and ice and stones—in short, a glacier. We will presume that this valley is of considerable length, and varying in width, that its contents (the glacier) move at the rate of about four feet in twenty-four hours. Such a powerful agent as would be represented by a glacier say of at least 4000 feet thick, as might be assumed existed under the Remarkable Range, would, when in its advance to the sea coast, by its enormous weight, break down, grind, and score the rocks over and by the sides of which it travelled; and when this system or ice period changed, we might look for its refuse in the shape of stray strange stones, abroad in the country, as its influence dried up—as, in short, we find in our own case from the coast to Mount Aurum.

So far as our knowledge extends as yet into this glacial period, its normal condition would appear to have been that of a steady advance from the highest peaks to the coast line, accompanied in its course by vast volumes of running water. The existence of this water, owing to heat of the sun and internal heat of the earth, as evidenced by hot springs and active volcanoes, presents an anomaly in this otherwise frozen period; but as the state of the earth and its atmosphere to-day is such that we find the heat, at some considerable number of feet high—say, at least, 2000 feet in this province—sufficient to

prevent accumulations of snow, it will be sufficient in this paper to assume the number of years during which this change was being effected, to have been of sufficient duration to have deposited the beds of drift we are considering. For a more graphic description than I can give of the vast power exhibited by the ice during this period, I must refer to the interesting work entitled *Frost and Fire.*

The wonderful power of ice I will not attempt to dilate upon or try to picture further. I will now ask if it is not possible to reconcile it with the features exhibited in the Queenstown, Dunstan, and Manuherikia Valleys, would the ice and its accompanying waters there sweep over all the lower side in its journey to its point of discharge—viz., the sea coast, and prevent in its pressure all appearance of any terrace formation, form the rounded hills at Queenstown, and what were formerly peaks of the Raggedy, Blackstone Hill, Rough Ridge, and Rock and Pillar Peaks, into fantastic shapes, and cover with its debris the lower spurs and convert them into rounded slopes, as we find them in the immediate neighbourhood of the Taieri and sea coast.

If I have carried you with me so far, I will ask you now, if there must not have been old main glaciers or river beds. Evidences exist in our midst of the activity of ice at one time, and though I have not yet seen shoulders of valleys and escarpments of rocks striated, I have found, in abundance, pieces in the shape of striated stones detached from these points, both in Dunedin and its suburbs, at the Peninsula, Green Island, and in a valley under Mount Watkin, at Waikouaiti; in each case on faces of elevation pointing up country. Specimens found in Dunedin, at the back of the Acclimatization Society's Grounds, are on the table before you. I will also direct your attention to the specimens of light-coloured cements, which I chipped from blocks of various sizes weighing from several tons to a few pounds, and which are to be seen lying on the surface of the schist formations extending along the Ida Valley, down the whole length of the valley of the River Molyneux from Cromwell to Waitahuna and the Woolshed, at Tokomairiro. At Moa Flat they are a considerable height up the ranges, and bear the appearance of having been but lately deposited. The brown-coloured cement I have seen in the Shag Valley, at Mount Watkin, and along the lower spurs of ranges at the West Taieri, in addition to large accumulations at Waitahuna and the Woolshed.

If we find signs of activity in the drift on our basins, as we traverse them from Queenstown through Cromwell, Dunstan, and on to the Taieri, I think we may fairly assume that we have what we desire, old river beds or deep leads. In each of these basins, I find the drift in them in bands or stratified, not lying promiscuously. Had the basins been each independent lakes, we might have looked for greater evidences of stagnation in the drift than I think is shown at present. Supposing, for instance, I tip from a dray a load of gravel, on cutting through it perpendicularly, no distinct pattern is observable;

it is a well mixed heap; and this I imagine would be the case with a gradual denudation or deposition from the surrounding ranges of these basins, had such denudation been precipitated into stagnant water, such as a lake would represent. Each mass or particle in falling would be precipitated irregularly, and present a homogeneous appearance; but upon placing a further quantity on the heap, and playing water on it for a time—performing these last two operations many times, and again cutting the heap in two—it will be seen that the parts influenced by the active water bear a distinct pattern. It will be stratified or appear in bands, and so agree with the deposits I have alluded to, which uniformly present this appearance of active aqueous action.

It is so at the upper terraces on the Shotover; at the big beach in the Queenstown Basin; the banks of the river at Cromwell, 75 feet deep to the present water level, bear the same appearance; and it is again repeated in the drift cut through by the Molyneux, through the Dunstan and Teviot Basins to the Beaumont, through the length of the Manuherikia Valley, and, I presume, down the Strath Taieri or Taieri Valley, though down this I have not been; at a considerable elevation up the spurs at Hyde Diggings, and at Dunstan Creek, at which latter place, in the claim of the Mountain Race Company, these bands, sometimes two or three feet thick, are elevated from the plain at an angle of about 45 degrees. The conclusion I came to after my hurried inspection was, that at one time there had been an outflow towards the Canterbury Province. But from a later upheaval, which would be shown in all likelihood by basaltic formation in the neighbourhood, these bands have been transferred from the level position in which I imagine they had been first formed, to their present position. This conclusion may be erroneous, as, whilst inspecting this claim in the depth of winter, two years since, a snow storm with fog came on, that compelled us quickly to return. An intelligent, and I may add very active, storekeeper, who was my guide, informed me that the deeper they went the better gold they were finding. It was a hurried inspection, and as hastily formed an opinion. The greatest elevation of the part of this ground worked was about 70 feet; below this depth they could not get a fall for their tailings, unless at considerable outlay in extending their tail-race. Within a few miles of the Woolshed, by Tokomairiro, at a new claim opened among the rounded hills, I found the same sign of active aqueous action.

At Maruwhenua, I am informed, the drift lies in distinct bands. At Dunstan, when the Fortuna Mining Company sunk to a depth of 109 feet without bottoming, and abandoned on account of the West Coast rush, the drift was found in bands. At Black's No. 3, very rich payable dirt was found at a depth of about 150 feet. At Mount Ida, in the Hogburn, a shaft was abandoned after sinking about 80 feet; at Waitahuna, the same, after sinking about 100 feet, not reaching, in either case, a proper bottom. At Wetherstone's Flat, at 432 feet, no result has been obtained, some asserting one thing and some

another; statements alternately being made that payable washdirt for the last 20 feet existed, and of an utter absence of the precious metal. This flat, in fact presenting a surface, I believe, for I have not been there, of not two miles square, and, in proportion to the large basins up country, most unfavourable to determine the existence of an old river channel. It is in the heart of most hilly, and I might say almost mountainous, country, and the shaft in question being sunk near the centre of the basin, would not afford indications or results such as I imagine may be proved by testing an outflow or inflow of one of the larger basins I have already alluded to.

The extent of the gold fields of this province has been given in the Government maps. If the wearing power I have attempted to describe is correctly stated, we should surely possess far richer spots than those yet worked, assuming that the rottenness of this vast range of country at present fills the different basins.

In concluding, I beg to thank Mr. J. T. Thomson, our Commissioner of Crown Lands, for assisting me with his experience in reference to ice evidence in Scotland, and in our explorations through Green Island.

ART. L.—*Notes on the Geology of White Island.* By JAMES HECTOR, M.D., F.R.S., Director Geological Survey of New Zealand. *With Observations on the Crystalline forms of the Specimens of Sulphur obtained.* By E. H. DAVIS, F.G.S., F.C.S.,* of the Geological Survey Department.

(With Illustrations.)

[*Read before the Wellington Philosophical Society, November* 12, 1870.]

IN the course of a voyage from Auckland, in April last, I had an opportunity of landing for a short time on Whakaari, or White Island, the well known active volcano situated in the Bay of Plenty, about fifty miles east of Tauranga. In the short time at my disposal I was not able to examine this most interesting locality with the care it deserves, but I made the following rough notes, and collected many specimens which have since been examined.

The island lies twenty miles out of the direct track of vessels crossing the Bay of Plenty from Cape Colville to the East Cape, but the weather being favourable for landing, the deflection from the ordinary course was determined on at an early hour, and during the morning we had the island distinctly in view. On previous occasions I had always noticed columns of steam rising

---

* While this volume is in the press, the small staff of scientific workers in New Zealand, on the 9th ult., suffered a great loss, through the accidental death, by drowning, of this talented and promising geologist, while engaged in surveying the Grey River coal field, on the west coast of Nelson.—ED. *March*, 1871.

from the island, even when at such a distance that it was below the horizon, and was therefore surprised to observe only a few feeble jets issuing from near the summit of the high ridge on the south side of the island. These jets were emitted in puffs, and were not visible until we were close inshore; the larger steam jets, which usually send forth volumes of vapour from the interior of the island, not rising sufficiently high to be seen over the encircling crater wall. I was informed that this quiescence is usual with a high atmospheric pressure, and this view certainly received confirmation on this occasion, as the barometer was 30·437, which is one of the highest readings yet recorded in New Zealand.

The south-west side of the island, which is the only aspect I had an opportunity of observing from the seaward, presents a steep furrowed slope, almost precipitous in some places, composed evidently of loose incoherent materials, of light grey colour in the upper part, supported along the shore by rugged reefs and cliffs of dark coloured rocks that withstand the encroachment of the waves. These harder rocks thus determine the outline of the island, and from the evident signs of stratification which they show where cut by the ravines, they appear to form a dome or anticline, on which the softer strata have been heaped in steeply sloping beds, as shown in the accompanying Section. The least precipitous part of this slope is covered with dense vegetation of a dark green colour, probably Ngaio scrub (*Myoporum lætum*). There is only one beach on this side of the island where it might be possible to land in very calm weather for the purpose of examining this vegetation, which appears to be quite inaccessible from the usual landing place. This latter is on the south-east side of the island, where there is a wide gap in the crater wall, partially closed however by an isolated hill, that prevents a direct view from the seaward of the amphitheatre and lake that occupies the central area.

Our landing was effected with some difficulty on large slippery stones, and as there is no sandy beach or sheltering reef, a very moderate surf from the south-east would suffice to render an approach to the shore impossible. A steep bank of boulders of various kinds of trachytic lava, strewn with driftwood, kelp, and dead shells, extends for a few chains from the sea, beyond which the surface of the interior of the island is formed entirely of tufaceous sinter, or fragments of volcanic rocks, cemented by a crust deposited by the evaporation of the water from the hot springs. This surface is absolutely barren, and intersected irregularly by fissures, from which sulphurous and other noxious vapours are exhaled. In some places it is treacherous, and perforated by holes, in the bottom of which soft gritty mud may be seen in a state of constant ebullition; but except in the vicinity of such spots, which should be approached with caution, the ground is sufficiently tenacious to bear a person's weight.

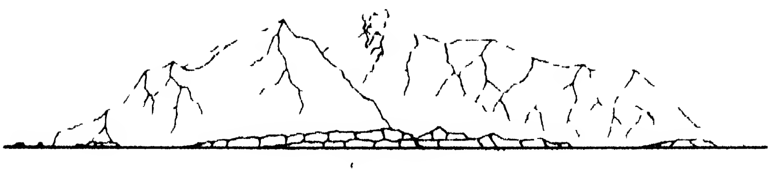
The desolate flat occupied by these sinter deposits has an extent of about thirty acres, and reaches an elevation of 60 feet above the sea-level, rising

gradually to the interior of the island between the lake and the sea, and occupying two-thirds of the space within the amphitheatre. The interior portion of the space is occupied by a hot lake, the water of which is strongly acid. The form and general appearance of this lake as observed by Dr. Rolston and Lieut. Edwin, of H.M.S. "Brisk," has already been described in our *Transactions* (Vol. i., p. 58), and by their survey it was found to have an area of fifteen acres. From their account it appears that the level of the water in this lake above the sea, undergoes great variations. On the occasion of my visit the water appeared to be at its extreme height of 25 to 30 feet above tide mark, there being no beach exposed on which it would be possible to travel round the margin of the lake as has been frequently done. Thus, Dr. Rolston states in the paper above referred to, that on March 16, 1868, "There was very much more water in the lake than when last visited, in November, 1866, which precluded the possibility of reaching the largest steam jets at the extreme north-west corner of the crater; but it was observed that these steam jets were not nearly so active as in 1866."

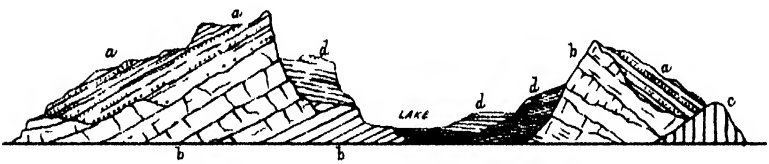
A cliff, 10 to 30 feet high, borders the lake where it is bounded by the tufa plain, but on each side cliffs rise perpendicularly from its margin to the height of several hundred feet. A small level area at the inner end of the lake, only slightly above the water level, is where the active geysers are situated. The general form of the island is thus a horse-shoe shaped range of hills, about 800 feet high, enclosing, on rather more than three sides, a level area occupied in part by the hot lake, and in part by the deposits from the hot springs which supply it.

As far as I was able to determine, the structure of the island is that shown in the accompanying section. The exterior layer of the island, so to speak, consists of a laminated deposit of incoherent breccia, or conglomerate (a), evidently the sub-aerial slope deposit that had, at an early period, been formed on the flank of a volcanic cone. This deposit rests on layers of lava and trachyte tufa (b), which are intersected by dykes (c). These rocks form the external wall of the crater, but, resting on ledges to a height of 200 feet above the present level of the lake, are laminated deposits (d) of a similar nature to the tufaceous sinter that is now forming round its margin, thus indicating that at a former period the crater wall was more complete, and that the water of the lake stood at a higher level relatively to the mass of the island.

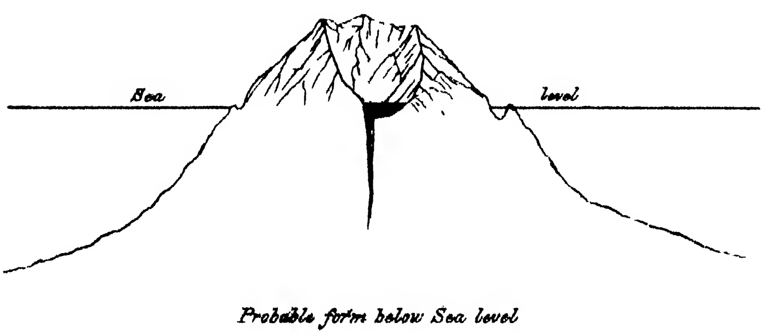
The manner in which this sinter is deposited on the shore of the lake appears to be as follows:—the water, which is of a deep green colour and has an average temperature of 110° F., deposits crystals of sulphate of lime when exposed to the air; these form a crust around the margin of the water, and as the level is continually fluctuating, this crust attains a considerable thickness and projects from the shore like a shelf, until it breaks down in large masses



From S W



Section through the Lake



Probable form below Sea level

WHITE ISLAND.

J. Hector del. J.B. lith.

Printed at the Gen. Govt. Lith. Press

to be renewed by a repetition of the same process. The shore built up of these incrustations is thus rapidly encroaching on the lake.

In the vicinity of the lake, and chiefly at a few feet above the water's edge, are round holes, in which boiling mud is kept in violent agitation by the escape of steam, and at the interior end of the lake occasional outbursts of boiling water take place, rising to the height of several hundred feet. The large masses of sulphur which are so frequently brought from White Island, are chiefly obtained from the vicinity of these geysers, but a considerable quantity also occurs as detached masses among the tufa. It is evidently deposited by the vapours that escape from the fissures, and it is doubtful if it could be obtained in sufficient quantity to have mercantile value.

When we take into consideration the great depth of the sea around the island, which is quite out of soundings according to the Admiralty survey, and the structure of its rock formation as above explained, it is evident that the present island must be the summit of a deeply submerged conical mountain; also, that the interior lake of hot water, in former times, stood at a much higher level, which was lowered as the sea waves effected a breach in the outer wall.

The overflow from the lake at the present time escapes by a narrow watercourse, which is being rapidly filled up by the incrusting deposits. We may expect, therefore, that in the course of time the damming back of the outlet will again permanently raise the level of the lake, but there appears to be very little doubt that, apart from all such causes, the water is liable to the rapid fluctuation of level which is characteristic of a geyser lake. I may remark, that I observed no signs of marine or beach drift within the crater wall, such as must have existed if the island had been undergoing process of elevation. On the other hand, the evidence seems to point to a steady submergence of the volcanic cone, the encroachment of the sea on the interior lake being prevented by the continual heaping up of the beach, thus keeping the sea water on the outside from mixing directly with the hot mineral waters of the lake.

We are thus led to the conclusion that White Island is the top of a submerged volcanic cone, built up during successive eruptions which took place in the atmosphere. Such volcanic rocks are naturally liable to undergo chemical change, and especially so if brought in contact with sea water, which, in this case, must permeate every part of the submerged mass. The heat generated by this chemical action is probably quite sufficient to give rise to the volume of steam, the constant escape of which is the only sign of supposed volcanic activity which the island now exhibits.

From the accompanying analyses it will be seen that the greater part of the deposits formed by the thermal waters on White Island are calcareous sulphates, and this, taken in conjunction with the large proportion of free

hydrochloric acid present in the water of the lake, of which it is the most characteristic constituent, would indicate that the decomposition of sea water is one result of the chemical action that is in progress.

These characters, and the absence of silica from the incrustations, obviously distinguish the thermal waters of White Island from the Puias and Ngawhas of the Rotorua and Taupo Districts, where the chief agent in producing chemical change must be rain and lake waters, which hold a comparatively small amount of mineral matter in solution. It therefore forms one of a third class of hot springs in New Zealand, in addition to the alkaline and acid springs which are so well described in Professor Hochstetter's admirable work on New Zealand (Chap. 18).

Samples were obtained of the water of the lake, and of the semi-fluid mud from the fumaroles, which have been analyzed for me by Mr. Skey, and the results compared with the composition of similar samples previously forwarded.

The water taken from the lake at a part clear from any incrustation, after standing for some time, deposited a slight sediment consisting wholly of gypsum in minute crystals. The transparent water then had a specific gravity of 1·088, and possessed the following composition :—

COMPOSITION OF ONE GALLON, IN GRAINS.

Hydrochloric acid	11,642·4
Sulphuric acid	1,405·6
Sulphurous acid	traces.
Alumina	627·2
Protoxide of iron, with a little sesquioxide	546·0
Soda	313·6
Potash	162·4
Lime	106·4
Magnesia	022·4
Silica and siliceous matter	023·8
Water	61,366·2
	76,216·0

Also contains traces of phosphoric acid and ammonia.

This proximate composition of the water may therefore be rendered centesimally as follows :—

Sulphate of iron	1·514
Sulphate of soda	·941
Sulphate of potash	·394
Sulphate of lime	·337
Sulphate of magnesia	·087
Sulphate of alumina	·115
Sesquichloride of aluminum	2·433
Siliceous matters	·031
Hydrochloric acid, *free*	13·631
Water	80·517
	100

The substances held in solution in this water are therefore as follows, in the order of the relative proportion in which they occur:—

1. Free hydrochloric acid.
2. Potash and soda alum.
3. Chloride of aluminum.
4. Gypsum.

On comparing this with the composition of the water in one of the fumaroles by the side of the lake, and which may be considered to contain in solution the whole of the constituents which have been extracted by the chemical action that is going on beneath the surface, being taken before the deposit of the encrusting matter, the following marked difference is observed:—

The solid part of the mud was first separated by filtration, and was found to consist of clay and other earthy matters, together with gypsum and iron pyrites in crystalline and granular forms.

The clear liquid was colourless and transparent, and possessed a powerful acid reaction and a specific gravity of 1·003.

It contained per gallon,—

Sulphuric acid	116·056
Hydrochloric acid	9·877
Lime	48·151
Soda	2·790
Potash	traces.
Magnesia	9·879
Iron protoxide, with alumina traces	11·356
Sulphurous acid	traces.
Phosphoric acid	traces.
Ammonia	traces.
Silica	9·631
Water	69,960·260
	70,168

These results show the saline constituents of the water are as follows, calculated centesimally:—

Sulphate of lime	·166
Sulphate of soda	·009
Sulphate of magnesia	·042
Sulphate of potash	traces.
Sulphate of protoxide of iron	·034
Sulphate of alumina	traces.
Sulphate of ammonia	traces.
Silicic acid, free	·013
Sulphurous acid	traces.
Phosphoric acid	traces.
Sulphuric acid, free	·016
Hydrochloric acid, free	·014
Water	99·706
	100

The specimens obtained from the edge of the lake are chiefly masses of sulphate of lime, sometimes in the form of massive gypsum, but more frequently crystallized in the form of oblique prisms of selenite. The faces of these crystals are frequently coated with crystalline films of pure sulphur, the forms of which have been examined by Mr. E. H. Davis, who has furnished the accompanying notes on the subject.

Notes on Crystallized Sulphur from White Island. By E. H. Davis.

This sulphur presents many points of interest, but especially in respect of its crystalline form. While examining the largest specimen in the Museum, I was struck by the peculiar arrangement exhibited by the crystals when examined with an ordinary pocket lens; this induced me to examine some more carefully under a microscope, and the result was so very striking that I propose describing the various crystals to the Society.

Sulphur, as is well known, crystallizes in the trimetric or rhombic system, usually in small pyramids, which are often very perfect; there are also many complex forms, a full description of which may be found in any Manual of Mineralogy.

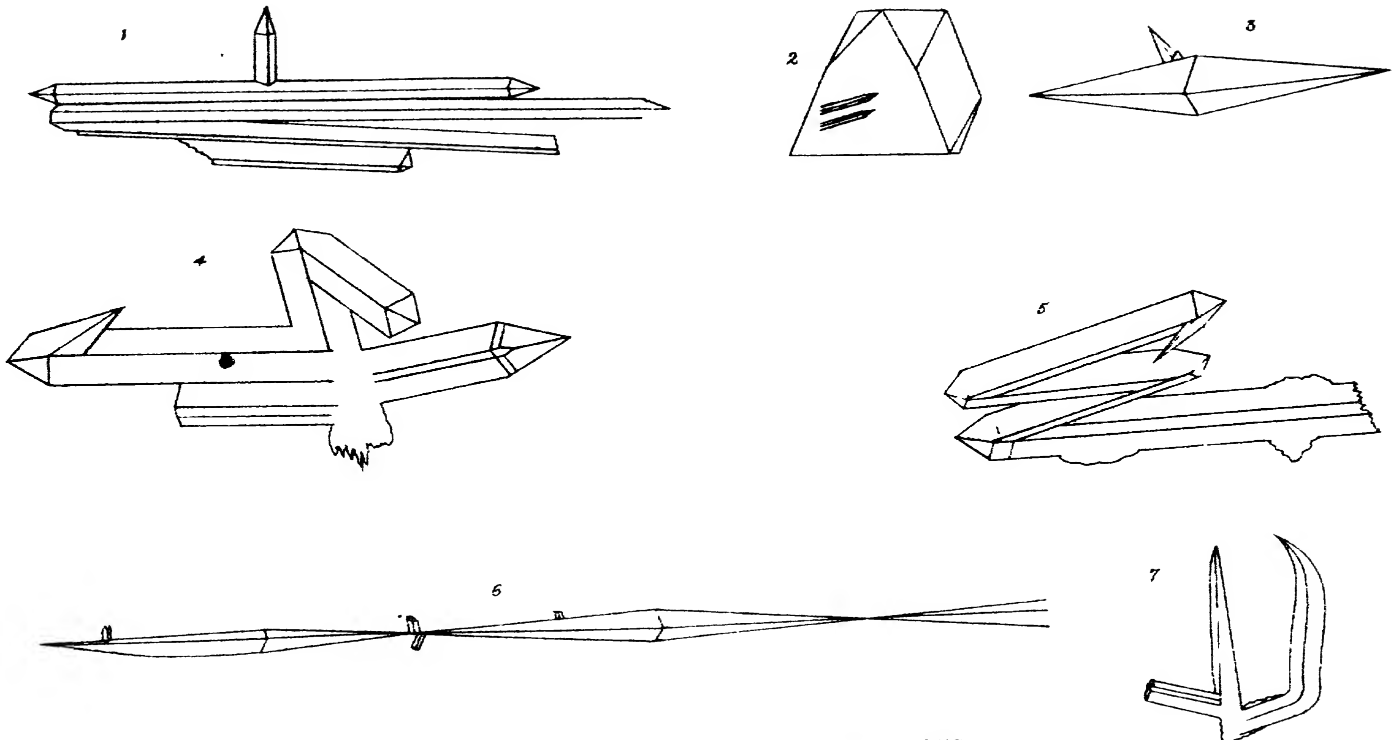
The form most usually affected by the White Island sulphur is the well known sharp acicular crystal, but it also assumes very much more complicated forms, some of which at first sight appear to be quite independent of all rules of crystallization.

No. 1 is a group of prismatic crystals attached to one another by the angles, and not the faces, of the macroprism which forms the apparent length of the crystal, the terminal planes being the faces of the macro-pyramid. The most curious feature about this group is the small crystal formed on the principal axis of the perfect form, on the top of the others; actually, this small offshoot is the chief of the group, being a normal prism terminated by an obtuse pyramid.

No. 2 is a regular rhombic pyramid, terminated by the basal pinacoid. This is a very common form, and would not have been worth noticing had I not fortunately thought of trying the effect of a polariscope on the crystal, when I discovered the two small crystals growing from one of the polar edges towards the centre of the crystal in which they were included. I strongly suspect that these were cavities originally filled with aqueous vapour, for with the blue light they were colourless, and with the orange, the same colour as the sulphur, or nearly so.

No. 3 is an acute pyramid with the brachydiagonal elongated and converted into the principal axis of a small crystal.

No. 4 is a most interesting group, two of the crystals being macrodomas terminated by trachydomas, one of the faces of the latter being continued and



CRYSTALL'NE FORMS OF SULPHUR FROM WHITE ISLAND.

E.H.Davis del. J.B. lith.

Printed at the Gen. Gov. Lith. Press

forming one side of an acute rhombic pyramid; these faces are all perfect, *i. e.*, smooth and brilliant, giving perfect reflections of light in any part; the other is a form very common in barytes, viz., pinacoid macrodoma, and brachydoma. This group was attached by the bottle-shaped mass of amorphous sulphur.

No. 5 is similar in structure to No. 4, but rather more complicated.

No. 6 is a series of pyramids attached by their apices, and having branches growing out of their sides.

No. 7 is a curious bent pyramid, but has nothing very interesting about it.

The groups 4 and 5 are not mere geniculations, as might be thought at first sight, for the direction of the new form is determined not by an axis, but by the theoretical direction of the face required to close the first or original form; again the faces are perfect, and not built up of alternate prisms and pyramids.

Nos. 1, 3, and 6, may be regarded as common macles, inasmuch as the axes are coincident.

I also detected a few oblique rhombic prisms, which would indicate that the crystals had been formed at a high temperature, or in the presence of steam.

ART. LI.—*On the Nomenclature of Rocks.* By E. H. DAVIS, F.C.S., F.G.S., of the Geological Survey Department.

[*Read before the Wellington Philosophical Society, September* 17, 1870.]

THE nomenclature of rocks is a subject which is involved in considerable confusion, and I regret to observe that geologists, instead of working together and helping to clear it up, are doing their best to make the confusion more confounded, by each one following a different system as far as possible, and thus not only making scientific intercourse difficult, but giving rise to no end of quibbles about words;—also, inducing a very loose way of thinking, and rendering all induction impossible. This lamentable state of things is more particularly striking in the case of syenites, and the purpose of this paper is to call attention to the difference between the English and American schools, as represented by Lyell, Dana, and Jukes, and the German schools, as represented by Bischof, Werner, Cotta, etc.;—the latter using the term syenite to express a distinctly plutonic basic rock, poor in magnesia, and closely allied to diorite and its congeners; the former using it to express an acidic rock, rich in magnesia, and allied to granite, gneiss, and schist; thus the one points to the probable presence of tin, copper, lead, and zinc, while the other only points to antimony and zinc. Gold and silver are common to both.

In all cases this difference is highly objectionable, but especially so here in New Zealand, where so little is known of the true structure of the country, and many parts are seldom visited by white men, it is of the highest importance that every one should call the same thing by the same name.

On the table are specimens of syenites of the different schools, and it will be at once apparent how much they differ; it will also be observed how nearly the one approaches a granite, and the other a diorite.

To compare the definitions of Lyell, Dana, and others :—

Lyell and *Dana*. Syenite resembles a granite in which the mica is replaced by hornblende, also that the felspar may be orthoclase or oligoclase; this is, therefore, eminently acidic, but the acidic character is not constant or characteristic.

Cotta, on the other hand, says that syenite consists of orthoclase or microlene and hornblende, which may have mica and quartz as accessories, but if either of these are abundant it at once becomes syenitic granite or syenitic gneiss—the difference is more apparent by comparison with diorite and granite.

SYENITE.

Dana :—Felspar, quartz, hornblende.
Cotta :—Orthoclase, hornblende.

GRANITE.

Dana :—Felspar, quartz, mica.
Cotta :—Felspar, quartz, mica.

DIORITE.

$$\left.\begin{array}{l}\textit{Dana}\text{ :—Felspar and hornblende}\\ \textit{Cotta}\text{ :—Felspar and hornblende}\end{array}\right\}\text{Triclinic.}$$

From the above it will be at once apparent that the German classification is not practical, *i. e.*, it cannot be used in the field, for it is rather too much to expect that a geologist, with only an acid bottle, pocket lens, and knife, can decide with any degree of certainty on the angles a half-embedded crystal makes, or the system it belongs to; for although orthoclase is monoclinic and oligoclase triclinic, still the angles are very nearly the same, (albite) 118°_a or 120°_o 86°_a or 90°_o etc., etc. The inconvenience of this classification is well shown by the fact that Werner, who first proposed it to suit a certain rock, subsequently called the same rock a diorite. If, however, the English system is adopted, there can be no hesitation in at once determining the quartz, felspar, and hornblende; felspar and hornblende come in as hornblende rock if the felspar is decidedly triclinic, if not, as a diorite.

The English school, or rather the American branch of it, has many claims to preference over all others, chiefly on account of its simplicity, and this simplicity is insured for some time to come, as the Americans have so much room for real practical science, and cannot afford to waste time and talents in multiplying names and then finding out some compound to suit them; the old proverb about a certain personage finding mischief for idle hands, applies to the natural sciences as well as anything else, for when a certain point has been

reached, many men seem to get tired of good healthy work, and instead of exploring fresh fields go over the old, and keep magnifying minor differences into groups of families, to the complete confusion of everything; forgetting that the great aim of all science is simplicity, and the more simple a science the grander and nobler it is.

Art. LII.—*On a New Form of Iron Pyrites.* By E. H. Davis, F.C.S., F.G.S.

(With Illustrations.)

[*Read before the Wellington Philosophical Society, September* 17, 1870.]

Iron pyrites has long been known as a dimorphous mineral, occurring crystallized in the tesseral and rhombic systems; the latter variety, called marcasite, occurs as a right rhombic prism — ∞ P 106° 5′, brachydome $\frac{1}{3}$ $\breve{P}$ ∞ 136° 54′, brachydome P ∞ 80·20 and a macrodome $\bar{P}$ ∞ 64° 54′ combined. The other form is common in cubes ∞ O ∞, octahedron O, and several semitesseral forms, the pentagonal dodecahedron $\frac{\infty O2}{2}$ the hemihedral form of the tetrakishexahedron, rarely tetrahedral; a common combination is that of the pentagonal dodecahedron with the octahedron, the faces of the latter replacing the trigonal angles of the dodecahedron. Macles are common, but are not material to the present purpose.

Plate XXVI., fig. 7., is a new form from the Chatham Islands. The lustre, specific gravity, and hardness, are the same as the common varieties; the system is oblique, nearly isomorphous with felspar, but having the clinodiagonal longer; the faces, which are smooth and brilliant, are ∞ P prism (*P*), OP clinopinacoid (*M*), P hemipyramid (*a*), *n*P∞ hemidome (*d*), (*n*P∞) clinodome (*n*).

The thick lines show where the crystal is cut off.

Art. LIII.—*Remarks on the Resemblance of the Country in the neighbourhood of the Dun Mountain, and Wairoa Gorge, to the Mining Districts of Queensland and Auckland.* By W. Wells.

[*Read before the Nelson Association for the Promotion of Science and Industry, April* 6, 1870.]

In bringing the subject of the present paper before the Association, I will at once state that I am indebted for the facts contained in it partly to my own observation, but more particularly to communications received from Dr. Hector, Mr. T. R. Hackett, and, latterly, to a very able report on the Rockhampton gold-mining district in Queensland, by Mr. Daintree, the Government Geologist of that colony.

These communications and observations all tend to show an almost perfect similarity of the country to that part of the Province of Nelson which lies between Motucka Gorge on the south, and D'Urville's Island on the north, the centre of which may be said to be the Dun Mountain.

Dr. Hector writes me as follows:—"I have just received a series of specimens of the gold-bearing rocks at Gympie, from Mr. Hackett, Queensland, and from their characters I have no doubt of their similarity to the Wairoa Gorge rocks and to some extent also to those at the Thames diggings. They have all the appearance of being true greenstones, and yet contain *Spirigera*, *Monotis*, and other Trias fossils; they are charged with pyrites, and cut by quartz reefs; and many of the specimens cannot be distinguished from those sent by Captain Hutton from the Thames. One specimen contains graphite markings, and resembles closely the plant-beds from Wakapuaka."

Mr. Hackett remarks on the similarity of the Dun Mountain country to that of the Rockhampton gold-mining district, as containing chrome ore, serpentine, gabro, schiller spar, copper ore, and iron ore; and in a previous letter, dated "Gympie," he writes:—"The new reef at Killiven, the place I wrote you of as being similar to the Dun Mountain, is turning out well, viz., ten ounces to the ton, where nothing is visible to the naked eye;" and he adds, "the Dun Mountain people ought not to be discouraged."

In Mr. Daintree's report, I wish to draw the attention of the members of the Association to a new and remarkable feature in gold-mining, as presented to us in that report, viz., the fact that it is no longer a necessity in searching for gold that we should first discover either quartz veins or quartz reefs for a matrix, and that it is now proved beyond a doubt that gold exists in rock masses in Queensland, both of felspar and serpentine.

Mr. Daintree, in his report, says:—"There are other matrices of gold, by no means self-evident, which call for more careful consideration as likely to yield most valuable results. These are—The auriferous serpentine rock of Block's claim, Mount Wheeler, and the auriferous felspar of Cummins's reef. In my report on the Cape River District, some twelve months since, I drew attention to the fact that the gold of Paddies' and Sharpers' Gullies had evidently been derived from a decomposed felstone dyke and not from quartz veins, and suggested that some of the upper portions of our felspathic 'dykes' might be remuneratively worked for gold. In the case of Cummins's reef, we have confirmatory evidence of this fact. This material, which has yielded, continually, half an ounce to the ton, is simply a crystalline pyritous felspar rock, about ten feet thick, bounded by greenstone walls, and whether considered as a 'dyke,' or the segregation in a particular zone of one element only of the boundary rock, adds to the conviction that we are at present entering on a new field in the occurrence of gold, the importance of which cannot be over estimated." "The auriferous serpentine," Mr. Daintree remarks, "of Block's

claim, Mount Wheeler, is a speciality hitherto unobserved, where the gold is absolutely quarried from the rock-mass, and there is no appearance of vein-stone in any way different to such rock-mass. On crushing and washing it yields, besides fine gold, chromic and titanic iron sand, so does (with the exception of the fine gold) all the serpentine from Mount Wheeler to Maryborough. At old Canoona, the evidence is all in favour of the same mode of development of the precious metal as at Block's claim. The bed-rock is serpentine—there are no quartz reefs, but where a matrix is found adhering to the alluvial gold it is serpentine, and, in addition, chromic iron sand is abundant in the drift. A fragment of mineral which appears to be decomposed serpentine, was lately forwarded to me by Mr. Josephs, the well known assayer, of Gympie, which was coated with carbonate of copper, and the locality from which it came had been taken up for copper mining, yet this, on assay, had yielded more than forty ounces to the ton. It may therefore be fairly concluded that serpentine rock may for the future be considered a field for the prospector, whether it be associated with quartz or not."

"These various novelties," adds Mr. Daintree, "in the occurrence of gold, enlarge considerably the supposed mineral areas of Queensland, and will lead to the careful prospecting of country which the Southern miner at all events would previously have passed over, and may in course of time, as our miners find their way South, lead to the opening up of gold fields where the surface rock formation has hitherto been considered unfavourable to the occurrence of the precious metals."

Another quotation from this report, as showing a very great similarity to the Dun Mountain and Wairoa Districts; Mr. Daintree, in describing Mount Wheeler, says:—"Chromic iron and chromic ochre are distributed over this serpentine country, and with a small proportion of titanic iron form the black sand so troublesome to the diggers. Very numerous outcrops of copper ore have been discovered in this district, which may be divided into three classes:—first, those derived from the decomposition of their pyritous veins, carrying a small amount of copper, which by decomposition and re-precipitation has impregnated the joints and cavities of the boundary rock to varying depths with earthy blue and green carbonate. This class of vein is, however, generally represented on the surface by a hard iron band, stained and coated with copper ore, but is more worth prospecting for gold than copper."

On this similarity I may remark, that it was the discovery of these iron copper-stained bands by Mr. Travers, on the Dun Mountain, led, as you are aware, to the formation of a company for prospecting and working the supposed copper lodes which the district contained. These iron copper-stained bands were first prospected by Mr. Wrey, and subsequently followed up by driving on their course, sinking by shafts, and cross driving, under the direction of Mr. Hackett, but without any result, except the picking out, now and again,

of a few small bunches of ore of variable quality, apparently precipitated into the crevices of the serpentine by solution from the decomposition of the outcrops of the neighbouring dykes, which run through that district in a course north and south. These bands in the Dun Mountain are of a similar character to those which Mr. Daintree remarks are more worth prospecting for gold than for copper; so it is just probable that, had the attention of the Dun Mountain Company been directed to the precious metal instead of copper and chrome, the results might have been very different.

The second class of veins, where the rock itself is pyritous, and the decomposing pyrites stains the joints and cavities with copper ore, sometimes for a considerable distance from the source of the ore itself. This mode of occurrence may be sometimes considered as a zone of impregnation, for, often a definite course can be assigned to a series of such outcrops. Two-thirds of the surface indications which have been discovered in the district have originated in this manner. The third class of veins are deposits of true copper ores in a matrix of quartz, calcspar, etc., with at least one defined wall, promising to become in depth true "lodes." The Pioneer Company's lode, at Collingwood, seems to belong to this class, showing a grey sulphide, and copper pyrites, in a quartz matrix, which has been tested with favourable results.

The foregoing quotations and remarks have been principally directed to the serpentine country. I now proceed to make a few observations on that section of country bounded by the serpentine on the east, and Blind Bay, as a likely field for the prospector for gold. This section may be said to rest on the Maitai slates. The slates run in a N.N.E. and S.S.W. direction, and are intruded upon at various points by greenstone dykes, and showing in their outcrop small quartz veins, such as are seen at the upper foot-bridge across the Maitai, within the boundary of the city, and said to contain gold. Several veins are also observable higher up the valley, as well as at various points on the line of the Dun Mountain Railway, where greenstone dykes, intersected by quartz veins, occur.

This class of country, Mr. Daintree remarks in his report, is highly favourable for gold-producing reefs. He says, in his report on veins entirely in greenstone:—"The mines Maria Louisa, Ball, Original Homeward Bound, and all the Crocodile District reefs, belong to this class. In Australia," he continues to say, "so far as I can learn, this mode of occurrence of auriferous veins has only been practically tested in Queensland. By personal inspection, I am aware that all the mines opened in the Black Snake District, near Kikivare, take their course through porphyritic greenstone, and some of the Gympie reefs are said to be so bounded." The peculiarity of veins of this character, he says, seems to be "that all yet tried have been proved to be auriferous, but associated with such an amount of sulphides as rather to deserve the name of 'pyrites lodes' than quartz veins."

The Thames gold field, in the Auckland Province, presents also a very great similarity to the Nelson section of country to which I have been alluding, being characteristic of intrusive diorite or greenstone dykes with quartzose veins highly impregnated with sulphides.

From the foregoing remarks, it will be seen that gold is found in rock masses, such as in the serpentine at Mount Wheeler, without any appearance of quartz veins, the matrix apparently being the mass rock itself; also, that the Maitai country is of the same age and character as the gold fields of Queensland and the Thames, from a comparison of the fossils and rock specimens by Dr. Hector and Mr. Hackett. These facts, I think, at least warrant us in presuming that the district in our immediate neighbourhood requires a much more careful prospective search than has yet been bestowed upon it.

I have directed the attention of parties connected with the Dun Mountain Company's estate, respecting the analogy between their property and gold mining fields elsewhere; and would advise parties who may have occasion to traverse that part of the country lying between the head waters of the Motueka River and D'Urville's Island, to look out for anything of the character of lode stuff, so that it might be tested for auriferous deposits. Serpentine shows in great force all through this district, and exhibits about the same strike, angle, and dip, as the auriferous serpentine reefs at Mount Wheeler.

Mr. Daintree publishes a table, giving the yield of gold per ton in the different districts embraced in his report, of which I have taken a summary extract, as follows:—

Mount Wheeler District—Serpentine, with pyrites. Five mines at work, yielding from 4 dwts. to 3 ozs. per ton.

Mornish District—Greenstone and sandstone, with copper and iron pyrites. Six mines at work, yielding from 7 dwts. to 4 ozs. per ton.

Blackfellows' District—Sandstone and slates, with copper and iron pyrites. Six mines at work, yielding 1½ oz. to 11 ozs. per ton.

Crocodile District—Greenstone, with copper and iron pyrites. Five mines at work, yielding from ½ oz. to 4 ozs. per ton.

You will observe that the presence of pyrites is a marked feature in all these mines, the treatment of which has always been a difficulty with the gold-miner. On this subject, Mr Daintree remarks as follows:—

"With the increasing depth of the mines the quantity of free gold diminishes, and that of the pyritous gold augments; so that greater attention must be directed to this branch of metallurgy of gold, or many good mines will have to be abandoned in consequence. In Victoria, this subject has been under the serious consideration of the owners and managers of most of the crushing machines, and general success seems to have been achieved both in

the saving of and the extraction of gold from the pyrites. The principles of the process are—

"1st. Concentration of the ore.

"2nd. The roasting-sweet, or until all the sulphur has been drawn off, and oxides only remain.

"3rd. The amalgamation of the roasted mass in a semi-moist state by trituration, and the collection of the finely divided amalgam by means of an additional large amount of quicksilver and water, and ultimate washing off. The saving and concentration of the pyrites is the most difficult operation, on account of the slight difference in specific gravity between the material to be saved and the quartz and other associated earthy matter. It has, however," Mr. Daintree observed, "been accomplished with tolerable success by Mundy's Patent Buddle, Stanfield's Patent Concentrator, and Thompson's Patent Percussion Table. Mr. Ulrich also recommends, as more perfect for this purpose, the Self-Acting Hydraulic Digging Machine, which he saw at work in the Hartz Mountains, and in the principal districts in Germany."

The roasting of the ore is effected in large reverberatory furnaces. One with special arrangements for this kind of work, patented by Mr. Lata, in use at the Port Phillip Company, at Clunes, is highly recommended.

For accomplishing the third operation, an "arrastres" is employed. Great care should be taken that for the trituration with quicksilver the stuff is not too moist.

With regard to saving the fine free gold generally associated with pyrites, and of which, on the latter account, there is no doubt a large amount lost in the tailing; Mr. Ulrich recommends the Tyrolese gold mills, which, on a recent visit to Europe, he saw at work in the celebrated gold and silver mining districts of Schemnitz, in Upper Hungary. These mills, which require but little attention and power to work, save gold too fine to be seen with the naked eye, from an ore composed of galena and iron, and copper pyrites, and are successful with even so little as two to three dwts. per ton.

I have brought this subject before the notice of the Association in rather a loose and unconnected form; but as the attention of prospecting parties has lately been turned to the Maitai Valley and neighbouring country in search of gold, I have some hopes that the facts and somewhat new features which exhibit themselves in the gold-mining districts of a neighbouring colony, under features almost identical with our own district, may be of some use in directing the search.

[In consequence of remarks in the above paper, both the cupreous and chromic iron ores from the Dun Mountain were analyzed, and in both, distinct, though small, quantities of *gold* were detected. From 120 grains of the former, the amount obtained is visible to the unaided eye.—J. HECTOR.]

Art. LIV.—*Notes on the Thermal Springs, in the Hanmer Plains, Province of Nelson.* By Julius Haast, Ph.D., F.R.S. *With letter from* Dr. Hector *to the Superintendent of Nelson on the same subject.*

[*Read before the Nelson Association for the Promotion of Science and Industry, May* 4, 1870.]

Amongst the manifold blessings bountiful Nature has bestowed upon New Zealand, to which hitherto very little or no attention has been paid, none deserve our consideration more than the thermal springs situated towards the central parts of both islands.

Owing to the difficulty of access, and the native disturbances, those in the North Island have generally been of little use to the colonists, although they are frequently resorted to by the natives; and I fear that it will take some time, from the two principal obstacles alluded to, before the colonists will be able to visit them with comfort and safety.

Of the thermal springs in this island, those of the Hanmer Plains, in the Amuri District, Province of Nelson, are the best known; but hitherto, from various reasons, of which I shall presently speak, they have been in most instances of no avail to those of our suffering fellow colonists who were in need of such remedies as they afford for the restoration of their health.

During a geological examination of the Amuri District, undertaken for the Geological Survey of New Zealand, I paid a short visit to these springs, and examined them as well as the means at my command would allow, and I now lay the observations I made before the Association. I hope at the same time, that these few notes will assist in making these valuable thermal waters—the healing qualities of which have in many cases been proved in a most remarkable manner—more accessible to suffering humanity.

The Hanmer Plains are about fifteen miles long, and two to three miles broad, and are without doubt a former lake basin, in which the Waiau-ua, the Hanmer, and some other smaller streams emptied themselves.

This lake, partly filled up by the detrital matter brought down by the rivers, at last cut the channel of its outlet so deep that it could empty itself by the gorge of the Waiau-ua, by which process the plains were formed as we now see them. The River Waiau-ua passes through their western side in a west and east direction, to about their central part, when it turns rapidly at right angle to the south, passing through the picturesque gorge over which Mr. Blackett, the Provincial Engineer of Nelson, has built that splendid bridge—the admiration of every traveller who passes that way.

However, before the Waiau-ua enters the gorge, it is joined by the River Hanmer, a small mountain torrent running in the opposite direction to the main river, namely, from east to west.

The shingle terraces by which these rivers are enclosed on both sides are

high and abrupt towards the south, where they ascend to an altitude of about 120 feet, rising gently on the northern side, and forming a shingle plain, with a great deal of swampy ground, cut through by numerous smaller rivulets and creeks.

The whole plains are surrounded by ranges 4000 to 6000 feet high, consisting of younger palæozoic or older mesozoic rocks, which, in many localities, are cut through by diorites, amygdaloids, and other trappean rocks.

About three miles in a north-east direction from the beginning of the Waiau-ua Gorge, and about 200 yards from the foot of the northern ranges, the thermal springs are situated. They occur over an area of about 2000 square yards, in a perfectly dry position, at an altitude of 1162 feet above the level of the sea, as calculated from a single barometrical observation. They are situated about five feet below the surface of the plains, and on a line running north-east to the south-west. There are four principal basins, having four smaller ones close to them, the outlets of which join together and form a swampy creek running into the Percival, one of the tributaries of the Hanmer.

We may safely assume, from the geological features of the country in which these springs take their rise, that they issue from a fault or fissure in the older sedimentary beds which has been formed in connection with trappean rocks, making their appearance at various intervals towards the close of the mesozoic period.

I have been informed that some other springs of similar nature occur on the northern side of the Percival Range, as well as on the southern banks of the Hurunui, above Lake Sumner, and these probably owe their origin to the same agencies.

Whatever their origin may be, these springs are very different from those of the lake regions in the North Island, which stand in close connection to the volcanic action still going on in that part of New Zealand.

The principal spring of the Hanmer Plains is situated in the north-eastern corner of the area. This basin has an average breadth of twelve yards. The water which it contains is perfectly colourless at the shallow sides, whilst towards the centre, which is much deeper, it has a beautiful greenish blue tint. It has a well-defined taste and smell of sulphuretted hydrogen. In the centre, at several spots, the water rises, continually throwing up large bubbles. Temperature on the sides, 97° 2′; in the centre, amongst the bubbles, on bottom, 104° 1′. Depth about eight feet. Temperature of air, 70° 3′; sky overcast.*

This largest basin, No. 1, is the one which has principally been used for

---

* I may here observe that I made the observations in the centre of the basins with a good self-registering thermometer of Negretti and Yambra, which we let down (Mr. Hugh M'Ilraith, who was my companion that day, kindly assisting me) by a flax rope drawn across the basin, and to which I had tied the instrument.

bathing purposes. Unfortunately, there is not the least facility for its use, as the small hut which one of the patients had built upon its banks has since been destroyed. The nearest locality where patients can find quarters is an accommodation-house, a few miles distant. It is therefore impossible for delicate patients to make any use of the springs at present, except under the most unfavourable circumstances, and with the imminent danger of aggravating their complaints by taking cold.

But notwithstanding all these great disadvantages, this basin has restored the health of many persons coming from various parts of New Zealand, and even from Australia. The greater number of the patients were sufferers from acute or chronic rheumatism, boils, and similar disorders; and from all I could learn from a few of them, and from some gentlemen in the neighbourhood, whose authority is reliable, the waters in most cases had a wonderful effect. It seems, therefore, that in many respects the springs may be compared with those of Aix-la-Chapelle, in Germany, and Cheltenham and Harrowgate, in England, which are used for the same complaints, and the principal mineral contents of which are sulphuretted hydrogen. Every well-wisher of the colony will, I am sure, share my sincere regret that these springs are still in their natural state, or even worse, being much disturbed by cattle, and that no means have yet been taken to have them enclosed, proper buildings erected near them, and to make their existence known over New Zealand and the Australian colonies.

Close to the large basin, No. 1, are two small shallow pools, one of which is situated at the south-eastern corner, and is only a few feet in circumference. The water, which rises in it in a few bubbles, has the same taste and smell as the main basin, with a temperature of only 78° 3′. This lesser degree of heat may be accounted for by the circumstance that the water rises only in small quantities in this spring, which has, like the preceding one, a fine muddy bottom.

Another small basin, No. 3, is situated at the eastern extremity of the principal basin. Its water showed a temperature of 106° 8′, and exhibited all the same properties which characterize the first described spring.

About fifty yards to the south of No. 1 is another basin, which has a diameter of ten feet. Numerous bubbles rise in and near its centre, where I found the temperature to be 103°, whilst on the shallow sides it diminished to 98° 1′. The water of this basin is also clear, and, although still showing the presence of sulphuretted hydrogen, this peculiarity is much less predominant than in that of the previously described springs. Its outlet is well defined, joining, after a course of about thirty yards, the swampy creek which flows from No. 1.

About thirteen yards from No. 4, in a south-west direction, another small basin is situated; it is very shallow, and the water (which has only a

temperature of 68° 9′) seems quite tasteless. Moreover, it has no outlet, the spring which feeds it being very small.

Still advancing seven yards towards south-west, we reach No. 6, a small intermittent spring, temperature 102° 2′, which fills a shallow basin about two feet in diameter. It is also strongly impregnated with hydro-sulphuric acid. In the outlet of this spring, which runs about three yards and falls into another larger basin, which I shall presently describe, a white powder is deposited, but of such a small extent that to collect some of it would have taken more time than I had at my disposal.

This is, as far as I am aware, the only spring where such deposits are formed, which, if carefully collected, would afford us reliable information concerning its mineral contents.

The next spring, No. 7, into which the outlet of the former falls, has formed a basin of a diameter of ten feet. Owing to the constant ebullition in many spots over its surface, the water it contains has a muddy appearance. It is the warmest of the whole series, registering 110° 5′ in the centre, whilst on the sides it falls to 94° 6′. It also shows the same characteristics of mineral contents as the foregoing springs. Its outlet, after the course of a few yards, joins the main creek.

Crossing this swampy watercourse, and ascending on its right bank, we soon reach basin No. 8, situated thirty-five yards from the north-east corner of No. 1. It is the second largest basin of the whole series, having a diameter of eighteen to twenty feet. Although numerous bubbles rise in different spots near its centre, so that it almost appears as if it were boiling, by which means the water is kept in its turbid state, its smell is less strong, and its taste purer than the former. I found the temperature in the centre 99° 7′, and on the sides 97° 8′, consequently very little difference all over the basin. On its western banks, a smaller shallow basin is attached to it, containing muddy water, strongly impregnated with sulphuretted hydrogen; temperature 99° 8′.

There is no doubt that, owing to the position of the springs, the water is not only greatly cooled by having to pass through a considerable thickness of sand and shingle, but also from the porous nature of the ground a further important dimunition in its temperature takes place by mixing with the leakage and surface waters.

This disadvantage also causes the mineral properties of the waters to be much diminished. Consequently, if the springs were properly enclosed so that they could rise unmixed to the surface as they issue from their rocky orifice below the shingle, they would improve in quantity and quality, as well as in temperature, and thus also doubtless in efficacy.

May I be allowed so suggest to the Association, the importance of having these springs properly surveyed, and of having collected from each a small quantity of water in well cleaned and corked bottles, to be sent to the Colonial

Laboratory for analysis, so that their mineral contents can be compared with those of well known springs in the northern hemisphere. I shall be truly gratified should these few notes assist in drawing the attention of the Provincial Government of Nelson to the great treasure it possesses in these springs, and that they may thus be made accessible to those of our suffering fellow colonists, who have hitherto only been deprived from using them by the neglected state in which they have been allowed to remain for years.

Further Notes on the Thermal Springs of the Hanmer Plains, by DR. HECTOR. *Communicated by His Honor the Superintendent.*

[*Read October* 5, 1870.]

"In reply to your request for any information I possess relative to the hot springs which occur on the Hanmer Plains, I beg to inform you that I examined them on the 8th May, 1867, and made the following notes at the time:—

"The altitude of the springs above the sea I found to be 1360 feet, and about 110 feet above the level of the neighbouring river. They occur on flat terrace land, under the range of hills that bounds the valley on the north side near where they are crossed by Jollie's Pass, leading to the Valley of the Clarence. I made my observations early in the morning, the temperature of the air being 52° F.

"1. A shallow muddy pool, twelve feet in diameter. Temperature, 50°5.

"2. At thirty feet distance from the above, and six feet lower, a pool of circular form, six feet in diameter, and more than eight feet deep, has a steady overflow and constant escape of bubbles of sulphurous steam. Temperature, 89°3.

"3. Twenty feet across, and seven feet deep close to the bank. Temperature, 89°5.

"4. Eighteen feet across, and more than ten feet deep. Temperature, 88°5.

"5. Several small pools around the sides of the two last, had a temperature of 90°5.

"There are, in all, three large holes and four small, the latter being about four feet in diameter.

"Four hundred yards to the east is an intensely green and cold spring, the water of which has a temperature of 43°, while the water in the neighbouring creek was 49°.

"The terrace on which these springs occur is composed of gravel and sand, and there is no appearance of any outcrop of rock nearer than the foot of the spur, which is 400 yards distant. There is no large deposit of silica from these springs as in the case of the geysers in the North Island. A small quantity of the water from the hottest spring was obtained for analysis, and gave the

following results :—Character : transparent, colourless, and tasteless ; decidedly alkaline to test-paper. A flocculent precipitate had settled, the amount of which was equal to 2·11 grains upon the gallon, and principally silica. The quantity of water was too small to allow of a proper analysis ; but the total of fixed matters in solution was equal to 86·4 grains per gallon, of which only 2·88 grains was silica. The remainder was alkaline chlorides and sulphates, but carbonate and sulphate of lime was present in moderate quantity, and the chlorides of magnesium and iron in much smaller proportion. Iodine was tested for with negative results, but it could hardly be discovered in so small a sample, unless present in notable quantity."*

* The difference in the temperature of these springs as observed on this occasion from that recorded by Dr. Haast, appears to indicate that they are intermittent and variable in their temperature.—Ed.

V.—MISCELLANEOUS.

Art. LV.—*On Changes in the Hokitika River.* By James Rochfort, C.E.

(With Illustrations.)

[*Read before the Wellington Philosophical Society, November* 12, 1870.]

From March, 1865, to November, 1869, it fell to my lot to watch the action of the floods on the banks of the Hokitika River, in Westland, and also the action of the sea on the sand and shingle forming the sea-beach there, and thinking that if made public, a knowledge of the facts that occurred might be of some use in similar cases, I beg to state such as I have been able to gather. The accompanying drawings (Nos. 1, 2, 3, 4, and 5) show the changes in the form of river mouth and banks at the dates noted on them, and the diagram (No. 6) shows the rainfall curve during 1865–6–7 and 8, from the meteorological observations taken at Hokitika by my brother and myself.

RIVER MOUTH AND SEA-BEACH.

The sea-beach at Hokitika is composed of sand and loose light gravel, continually shifting with the action of the waves and currents, which sometimes set northwards and sometimes southwards, depending on the direction and strength of the river current at the mouth of the river, where it meets the sea. In June, 1865, the river channel on reaching within six chains of the sea, was turned southwards, parallel with the coast line, by a spit of sand half a mile long and six chains wide, and this spit was continually altering in length and thickness, the river in floods cutting in very quickly in the bend, and depositing the stuff so taken away at its south end, adding to its length, till, in February, 1867, its length had increased to fifty-four chains; this weakened it so much in the bend that, in April, 1867, the sea made a breach there, washing the crown of the spit over into the river, each wave at high-water washing over a certain quantity of material, and the continued action of the sea thus shifted this part of the spit several chains inwards, at the same time reducing its height considerably; and, on the 18th of April, 1867, during a flood, the river broke through at that part, cutting off about thirty-six chains. For some time after this occurred, the channel thus formed was unstable, the mouth having no protective spit outside, and the north end of the middle bank was driven in by the sea, until the water coming down the lagoon and south channel of the river was prevented from reaching the sea by

the new channel, and for some time the south channel was generally used by vessels, and their cargoes had to be transhipped by boats from the vessels lying in the lagoon to the wharf, which they reached by going round outside the middle bank, there being an available channel there for boats within the break. During the whole of this time, a long spit tailing out to sea from the end of the old south spit, which had formed a protection against a southerly sea, was being driven in, until eventually, in August, 1867, it overlapped the middle bank as much as eighteen chains in length, and very shortly afterwards was driven home on to it. I may remark, that the old south channel remained deep and workable for vessels until within a short time of its closing up, although, except in floods, when a small quantity of the river water came down the south river channel through the lagoon, the only water finding its way to the sea by this channel was supplied by a few small creeks, and the tidal water which flowed in and out of the lagoon.

In October, 1867, serious trouble befell the inhabitants of the west side of Revell-street; the sea encroached so fast on the beach at the rear of the houses on that side of the street as to threaten their destruction. I believe this to have been principally caused by the set of the current, induced by the action of the river current and the sea together, aggravated by particularly high tides and strong westerly winds. The effect of the action of the water was to carry away the sand and gravel to a depth of 6 or 7 feet, depositing it again either northwards or southwards, as the current happened to tend, leaving a perpendicular face of 6 or 7 feet, in some cases even more, which every successive tide pushed inwards considerably.

To oppose this I tried groins formed with timber caissons, filled with gravel, each 20 feet in length and 12 feet wide in the bottom, the sides having a batter of one to one; these caissons were simply laid on the sand end to end, running out perpendicularly to the beach line, each groin being about 120 feet long and 5 feet high, the outer ends having the same batter as the sides. The first one was put down on October 26, 1867, and four more during the last three days of November; each groin was completed in a single ebb tide. They were placed about three chains apart, with two tiers of fascines sunk in the sand, stretching across from groin to groin at the inshore end, a space of about 15 feet being left between the tiers. The good effect produced by these groins was at once apparent, the heavy seas being broken, and a tendency to deposit instead of scouring induced. The drawing (No. 5), shows another action of the river at the part protected by these groins. During the dry weather, when the river was low and south-west winds prevailed, the south spit was driven up northwards until it overlapped the north spit more than forty chains, and drove the river against the beach, until serious fears were entertained for the houses on the west side of Revell-street; the river channel being reduced by the washing in of the south spit, cut in deeply on the beach, which it under-

mined and carried away, keeping an upright face of some 6 or 7 feet; when this face reached the groins, the caissons, one by one, as far as the river current affected them, dropped about 5 feet, but once down kept their position, effectually canting off the river current, and once up to the groins the upright face disappeared and the beach took a sloped form with a fall of about one in fifteen; and I am of opinion that these groins prevented the river from cutting into Revell-street and destroying many valuable buildings. The drawing shows the spit after the river had broken through it, but I have shown in dotted lines the shape of the spit before this took place. It will be seen on looking at the rain diagram, that the year during which the sea encroachments took place is remarkable as having the least rainfall, and consequently the effect of the sea on the river current would be at its maximum.

The islands shown off the two spits, in drawing (No. 2), were banks of shingle, which were afterwards driven on to the spits, and materially strengthened them. In December, 1867, during a heavy flood, the river again broke through the north spit, running straight out, this was caused by a wreck (the "Gratitude") which was lying on the north spit, on the river side, about five chains from where the river turned southwards; the river first ran over in a very small stream to the north of this wreck, but its position causing it to act as a groin, the whole river was very soon turned across the spit to the northwards of it. The wreck had afterwards to be removed by blasting, as it was causing the river to do a great deal of damage to the north point.

I noticed after this that at low water the river was 3 feet lower than before, and the floods were not so high by about 2 feet. The surveys of February and May, 1869, show the gradual settling down of the form of river mouth under the new circumstances.

THE RIVER AND HARBOUR.

The river brings down a great quantity of shingle, and thus causes continual changes in the position of the channel. The banks generally are composed of vegetable mould and sand, deposited by the river at different times; one of these layers, below the water level, has a great deal of sand in it, and on this the river acts very quickly, undermining the bank above, which often falls in where unprotected by some yards at a time.

There is no large stone near the town such as would answer for protective works, and to fetch stone from the Kanieri would, in the earlier time of the diggings, have been too expensive; works of that kind were therefore necessarily formed of destructible material. The first part of the wharf was formed with piles, driven 10 feet into the solid, sheeted behind with horizontal planking, tie piles being driven 20 feet back, and timber horizontal ties connecting them with the face; the space behind the front face was then filled in to the level of the capping with brushwood at bottom, and then gravel. The filling with

gravel was afterwards found not to answer, as the river undermined the sheeting, and the gravel ran out, thus destroying the roadway of the wharf. Long sheet piling, driven from 12 to 15 feet into the solid was also tried, but eventually it was found that the work most suited for the river was formed with strong piles, driven as deep as they could be driven, about 6 feet apart, with a capping tied to back piles, and the space behind the front piles filled in with brushwood; the roadway of wharf being formed with planking, on stout bearers. The brushwood if weighted slightly, when a scour took place, sank, and took the place of the soil scoured away from below it; and with careful supervision the work stood very well.

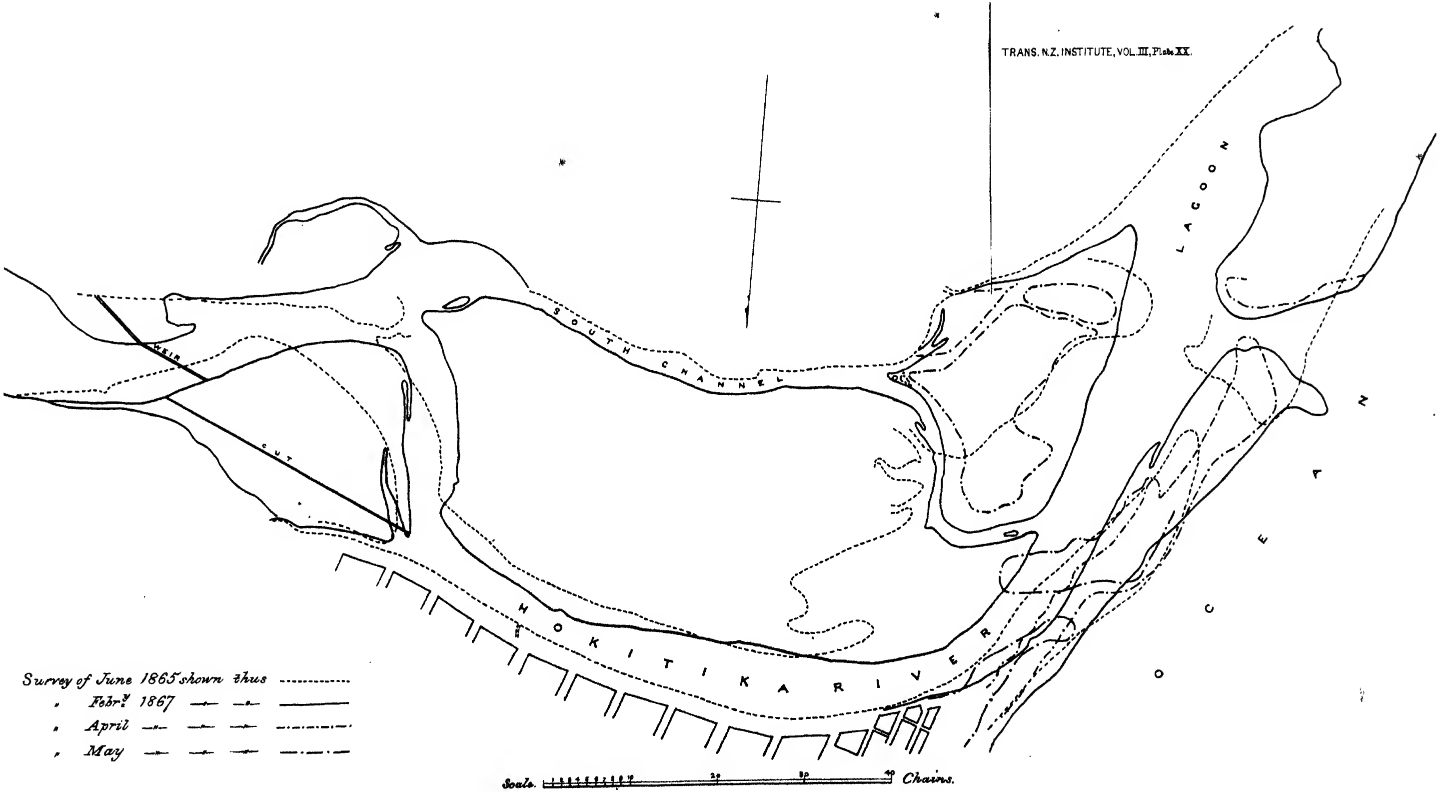
In forming the wharf and such protective works as were done, care was taken at first to keep the form of the bank in one regular sweep; this was done for the purpose of keeping the channel as regular as possible where navigable, and also to keep the water together to gain the whole effect of the river current on the bar, which was considered the most likely course to keep the bar low and give a good channel.

In 1868 the wharf and other river works passed into the hands of the Corporation of Hokitika.

RIVER DIVERSION.

In 1866 the river showed a strong disposition to leave the channel running past the town, and resume a former channel next the opposite bank, between which and the town there is an island, shown in the accompanying plans. The late Mr. Balfour, who was there at the time, recommended that a dam should be thrown across this channel in its narrowest part, and he was of opinion that if this could be completed without a serious flood taking place while the work was going on, that it would cause the river to deposit silt above it, thus securely stopping the south channel; unfortunately however, this dam was carried away when half finished by a very heavy flood. After that, a wattled weir, about 18 inches above the surface, was carried across the broad upper part of the mouth of the channel, and this prevented it from being scoured deeper until the river had shifted its channel to the weir, when of course it was undermined and partly carried away. The shingle bank above the town, shown on the plan, had by this time extended southwards so far as to push the whole body of the river close into the mouth of the south channel, and unless some action had been taken the whole of the river would have left the wharf and taken that channel.

In February, 1867, a cutting was made through the bank above the town, and a weir was put in across the river, as shown on the plans. The cut was 8 feet wide in the bottom. The weir was formed with caissons filled with gravel, similar to those described before as used at the groins on the sea-beach, the depth being made to suit the depth of water; the top of the weir was

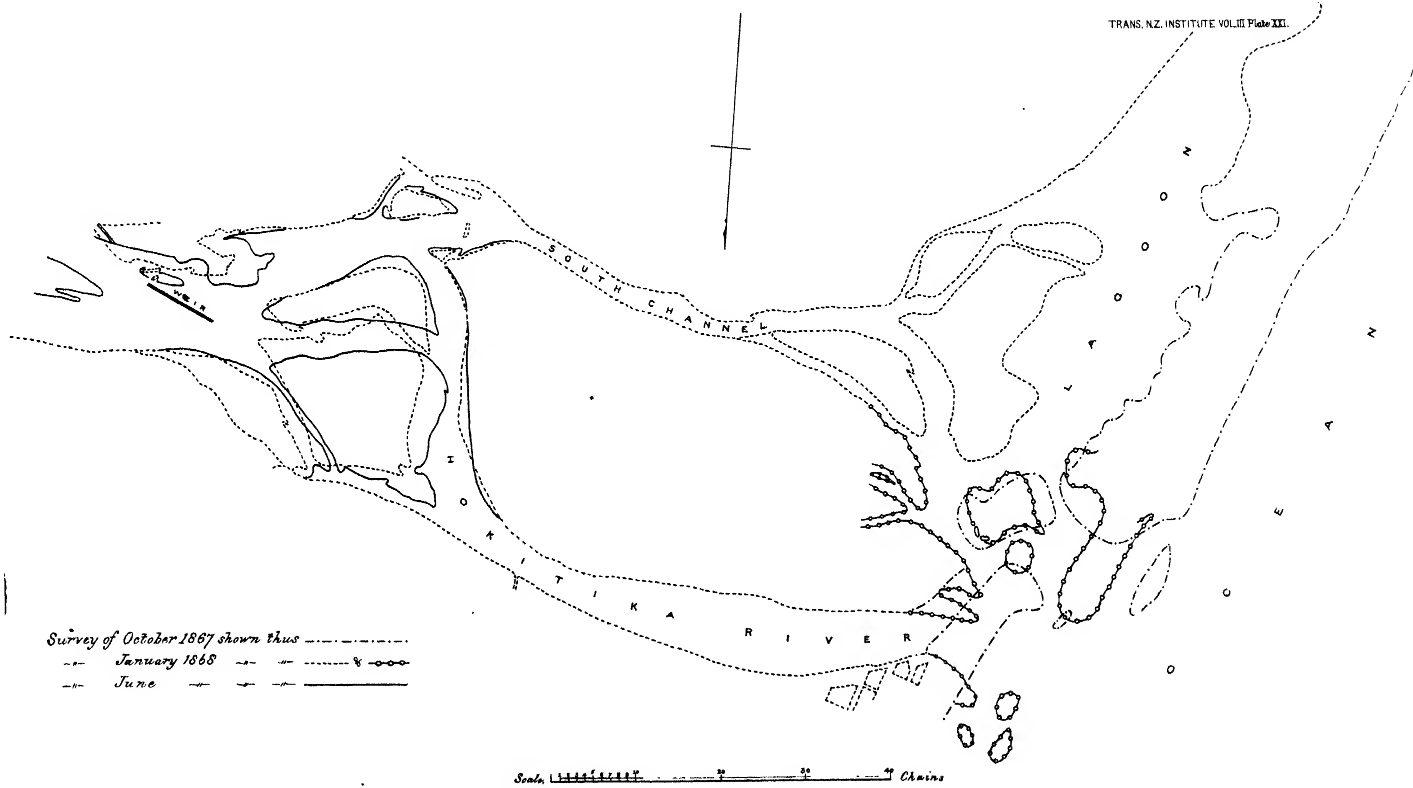


DRAWING SHEWING CHANGES IN HOKITIKA RIVER,

FROM JUNE 1865 TO MAY 1867

J. Rochfort del. J.B. lith.

Printed at the Gen. Gov. Lith. Press.

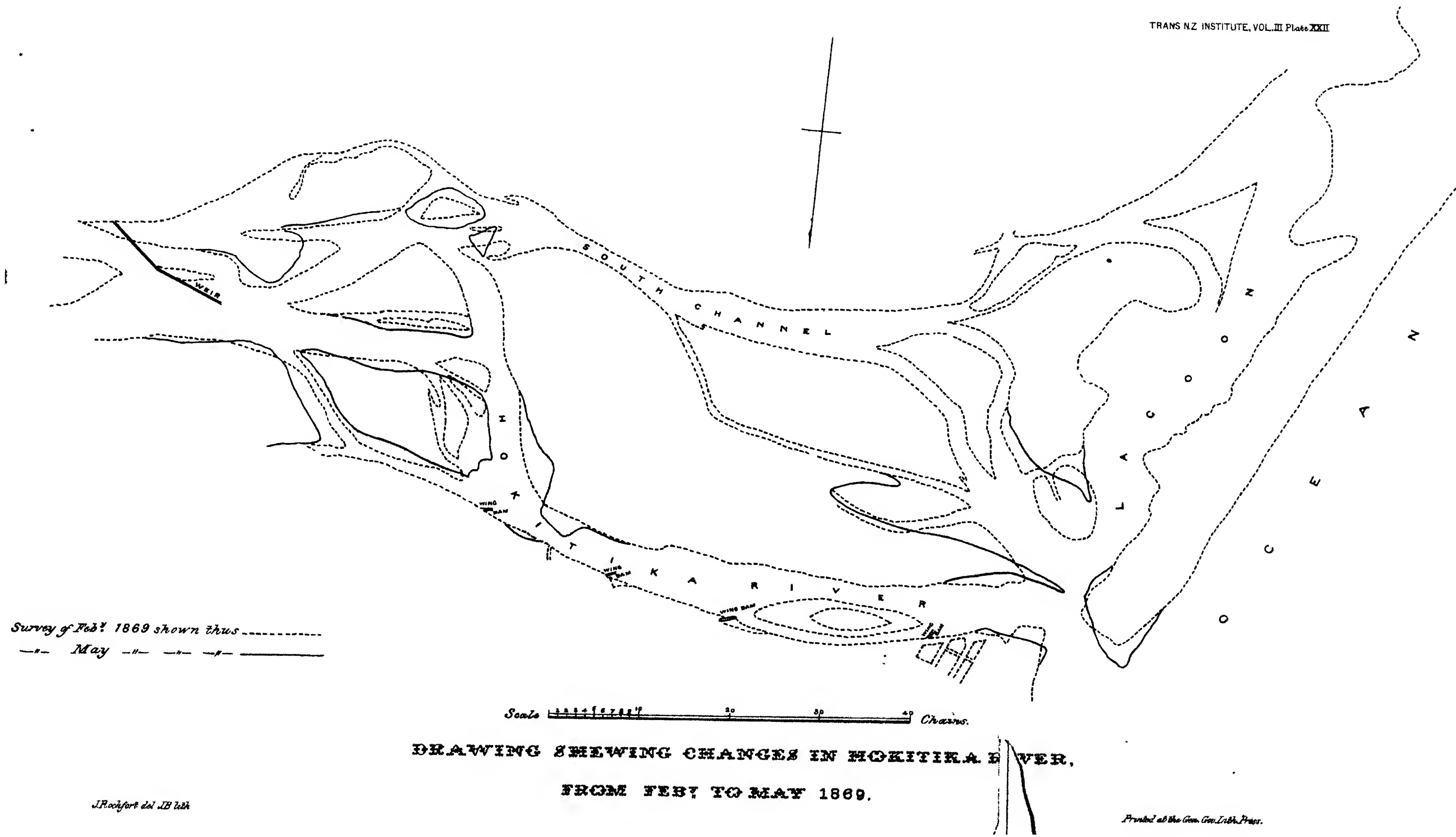


DRAWING SHEWING CHANGES IN HOKITIKA RIVER,

FROM OCTOBER 1867, TO JUNE 1868.

J. Rochfort del. J.B. lith.

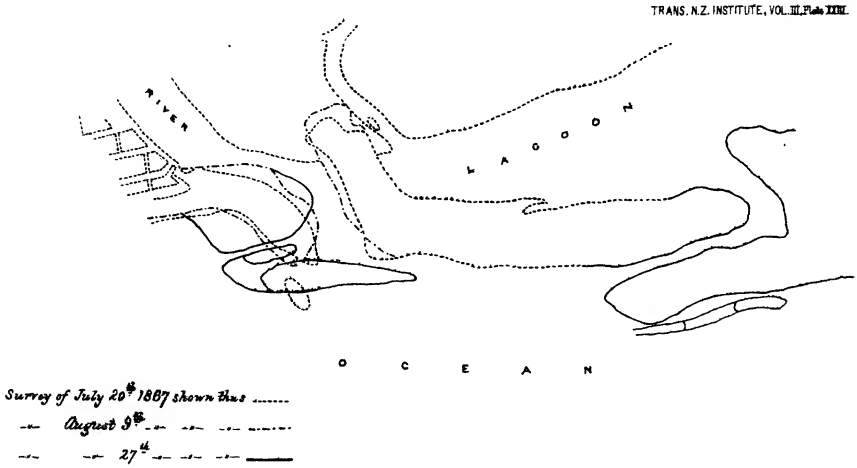
Printed at the Gen. Geo. Lith. Press



DRAWING SHEWING CHANGES IN HOKITIKA RIVER, FROM FEBʸ TO MAY 1869.

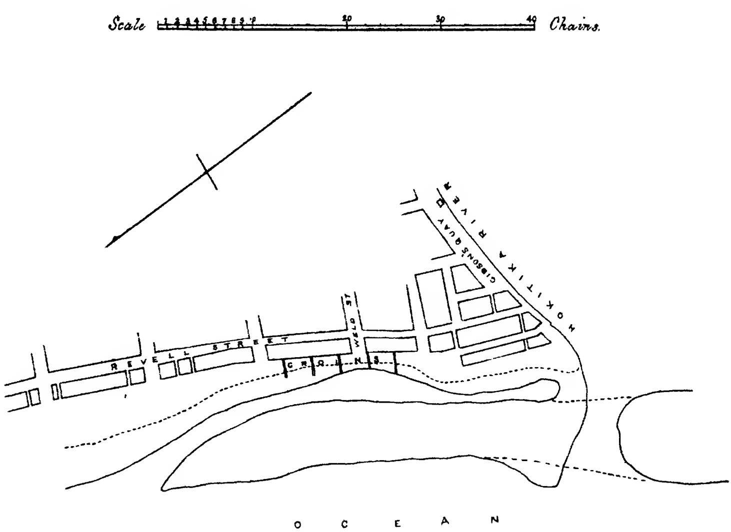
J. Rochfort del. J.B. lith.

Printed at the Gen. Gov. Lith. Press.



DRAWING SHEWING CHANGES IN THE HOKITIKA RIVER.

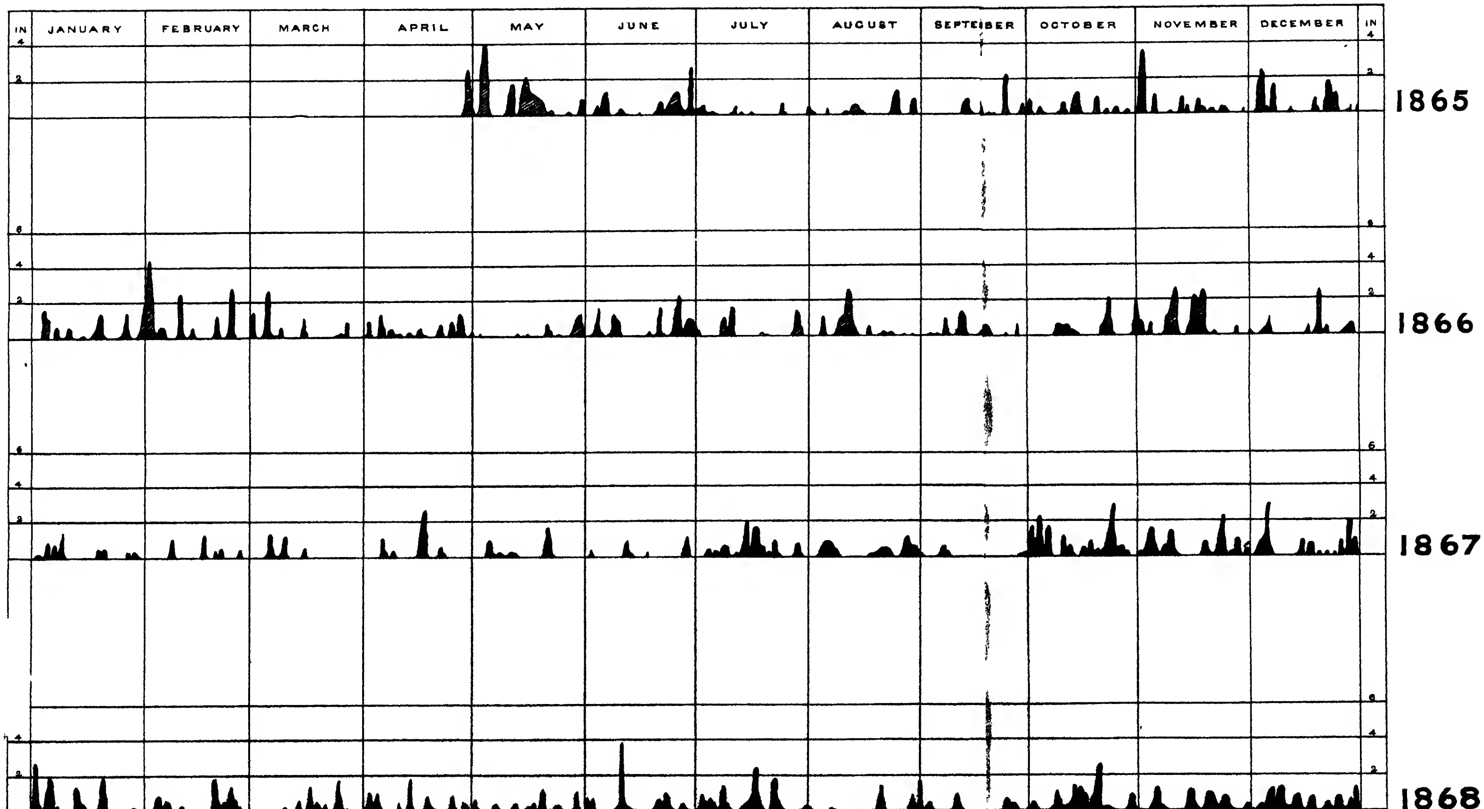
FROM JULY TO AUGUST 1867.



HOKITIKA RIVER MOUTH, OCTOBER 19th 1868

J. Rochfort del. J.B. lith. Printed at the Gen. Govt. Lith. Press.

DIAGRAM, SHEWING THE RAINFALL AT HOKITIKA, DURING THE YEARS 1865.6.7.8.



J. Rochfort del. J.B. Lith.

Printed at the Gen. Gov. Lith. Press

kept to the level of low-water. The low shingle bank at the south-east end of the weir was crossed by a pile and brush dam, on the line shown on the plan, carried up to the main bank of the river.

This work was finished on March 25, 1867, and from that time, in floods, about half of the river water passed across the shingle bank, scouring out first a channel trending in towards the north bank, but eventually the large channel shown on the latest plan, and this channel now took the whole of the river water except in heavy floods, and the old channel tending towards the south channel became smaller and smaller until it was nearly filled up. This would have taken place earlier but unfortunately the work for some eighteen months was neglected, and a gap of considerable width in the pile and brush part of the weir, caused by the passage over it of an immense tree in a heavy flood, was left open the whole time, thus considerably diminishing the scouring action of the river on the shingle bank in floods.

ART. LVI.—*On the Gyration of the Wind in New Zealand, with its Characteristics in the Various Quarters.* By W. S. HAMILTON.

(AUTHOR'S ABSTRACT.)

[*Read before the Wellington Philosophical Society, August* 20, 1870.]

THE extreme changeableness of the weather in the Southern Hemisphere is a well known characteristic of its climate. In this respect New Zealand is no exception from other southern lands. This is caused, in these regions, by the very regular rotation of the wind through the different quarters, together with its strongly marked characteristics while in these quarters. The striking regularity of these gyrations of the wind is one of the first indications of a change of hemisphere which is encountered by the voyager from Europe, where they are less regular from the greater mass of land producing local winds and disturbing the general atmospheric currents of the world. The moment the Cape is passed, these gyrations of the wind through N. to W., S., and E., with their strongly marked characteristics of warm and dry for the N., stormy and wet for the W., cold and damp for the S., and calm for the E. winds are experienced, up to at least the 50th degree of latitude.

Although the primary cause of these gyrations is now understood to be due to the earth's axial motion, modifying the direction of the great polar and equatorial currents of the atmosphere, still there are many points not yet positively settled in the theory of these winds. Some of these are the *period* of rotation, whether constant for different latitudes, different seasons of the year, and for different hemispheres,—whether it coincides in any way with the ephemeris of the moon,—at what latitude the cycle is equal sided, that is when the winds pass through the various quarters in about equal times,—at what

latitude these gyrations cease to be felt S. and N.,—and also, how the winds from the various quarters displace each other. On these various points I have but a limited amount of facts to adduce from my own observation, but though the quota is small it may call attention to these interesting points, and accumulate by eliciting the experience of others.

The period of complete gyration seems to be, as nearly as possible, seven days. In Victoria, the hot winds generally keep the same days of the week for months together, as also do the wet days in winter, both of which are coincident with—one the N., the other the W. wind. In New Zealand, these gyrations are more irregular than in Victoria, arising, no doubt, from the more irregular form of the land, and its greater elevation causing greater disturbance to the normal winds. Still, these rotations are well marked and tolerably regular throughout the entire length of the country. In Victoria, the wind rotates through the several quarters in nearly equal times, with perhaps a little skip through N.W.; in New Zealand, it often lingers in one quarter for a longer period, sometimes for an entire rotation, or even several. When it does so, however, the period is generally marked by a calm of longer or shorter duration; often for only a few hours, when the wind begins to blow with renewed vigour from the old quarter for another seven days. This, however, is seldom the case; in general, the wind rotates very regularly. In Southland, it is fond of lingering in the S. beyond its due time, and then backing through W. to N.W., where it would have been had it gone regularly round; when it does so, it blows with great violence, from N.W. for some time, often for two days, then passes in a stormy mood through W. to its home in the S. In bad weather, it thus oscillates through an arc from S.W. to N.W., each succeeding oscillation being more stormy, and the arc more contracted. In the north of the island, this is reversed, where the N.W. is the prevailing wind, and the N.E. gales the severest.

In the middle of the islands, the cycle is more equal sided, so that it would appear that between latitude 38° and 41° is about the middle of this zone of gyrating winds in New Zealand. By careful observation, the period, though more obscured by local and other disturbances than in Australia, can be made out, and appears to be about seven days throughout, so that it appears to be independent of latitude. The seasons disturb the regular course of the wind greatly. In spring, the wind holds longer in the N., and in late autumn, longer in the S., than during summer and winter, when it is generally more regular. During spring and autumn, it is often difficult to make out the complete revolution, but it is observable that when a well-marked crisis occurs, it is generally at the time when it would have been had the wind made its regular rounds, though a long period of disturbance may have intervened. This would argue that the true period is also independent of season, though these may obscure it for a considerable time.

Since the N.W. passage of the wind is the critical time for rain, a knowledge of the wind's days enables us to forecast the days which will be precarious in this respect. In bad weather, there are often two revolutions in one true period, and then there are two critical days in the week—the secondary often being greater than the primary. At other times, the wind remains steady at one point for a whole period, or even two, the crisis being marked by a few hours of calm.

The exact determination of this period over long intervals is a problem of great interest, as it would help to throw light on the causes which determine the period, whether it has any connection with the phases of the moon, as has often been conjectured, or is the result of a certain equilibrium between the strength of the polar and equatorial currents and the earth's axial motion, or other causes.

The characteristics of the wind in the different quarters are well marked and constant. The warm N., the stormy and rainy N.W. and W., the cold damp S., and the calm dry E., are invariable. The barometer also invariably rises with a S. and E., and falls with a N. and W. wind. The manner in which the various winds displace each other is also a point of scientific interest. Professor Dové found that the S. wind was blowing in the upper regions before it descended to the surface in the Northern Hemisphere; or, in other words, that the N. wind there displaces the S. wind first in a thin stratum at the surface, acquiring depth as it advances. He found that at the Peak of Teneriffe it is often blowing a S.W. wind when the N.E. wind is blowing at the base. The corresponding case seems to be true for the Southern Hemisphere, since at elevated stations, such as Bealey, the wind is often N.W., while the S. wind has set in at lower levels. The barometer also gives similar evidence, as it rises only when the S. wind actually sets it, while it falls for some time previous to the advent of the N. wind at the surface.

The occurrence of our white frosts before a N. wind and rain, would thus receive an explanation, as being the result of the warm dry N. wind in the higher regions bearing down towards the surface on the strata of cold damp S. wind, and by its evaporating power changing the vapour from a grosser to a finer state of particle, and hence causing cold in the regions below from a well known law, the intensity of the cold becoming a measure of the rapidity of evaporation and the approach of complete saturation or rain.

Another interesting point is the bearings of the line of displacement. This could only be determined with any accuracy by a combined system of simultaneous observations at distant stations free from much local disturbance. The form of the advancing area within which the S. wind is blowing, and the velocity with which it travels, are also points of great importance as indicating the probable path of cyclonic disturbance and the rate of their advance, both of which are found to be totally independent of the direction and force of the

wind within the storm itself. Any observations I have had the opportunity of making are totally inadequate to determine any of these elements, and can only leave the subject in the hope that others having better opportunities will work it up.

ART. LVII.—*On Periodic Vertical Oscillations in the Earth's Atmosphere, and the Connection existing between the Fluctuations of Pressure, as indicated by the Barometer, and Changes in the Weather.* By H. SKEY, Government Meteorological Observer at Dunedin.

[*Read before the Otago Institute, August* 9, 1870.]

THAT vast commotions take place in this aerial ocean, at the bottom of which we live, is proved not only by the fluctuations of the barometer, but by every gale that blows; and the study of those laws which have been given to nature, by which all the meteorological phenomena we perceive are effected, is engaging the attention of many. Many kindred sciences meet in atmospheric investigations, but it is proposed, on this occasion, to consider only some of the mechanical, thermal, and chemical laws which influence the weather.

Great differences in the amount of solar heat received by the earth occur at different latitudes, and also in different degrees at the same latitudes, arising from the varying power of the air to transmit heat; and it has been shown by Tyndall that though air laden with aqueous vapour may retain its transparency to light, yet the heat rays are nearly all checked in their transmission, being absorbed by the watery vapour.

When, therefore, masses of air are thus differently heated, the more heated portion expanding, ascends, and denser air rushes under to restore equilibrium. But the motion imparted to the atmosphere does not end here. If we suspend a weight by an elastic string, we shall be enabled in some measure to illustrate the effect of motion imparted to elastic substances. Mark, first, the position of the weight while free; this will indicate mean pressure and equilibrium. If it is now pulled down, the maximum pressure will be shown; and when relieved of the maximum pressure, the weight not only goes back to the mean, but nearly as far above as it was pulled down below it, and will continue to vibrate vertically until brought to rest by friction. Observe, also, how regular is the time of vibration. In such a highly elastic medium as the earth's atmosphere, any portion of it being compressed and then relieved from pressure will expand in virtue of its elasticity; and from its inertia, as expressed in the first Newtonian "law of motion," will continue its expansion until it exceeds its original volume, after which it will again contract, and thus oscillate on alternate sides of its mean volume. Now, when any large mass of the air is raised above the mean height of the atmosphere, the direction of the main

component or force afterwards acting on the mass would be towards the earth's centre, or vertically downwards, owing to the attraction of gravitation. Take a straight vertical glass tube, open at the top and closed at the bottom, the lower portion containing air, above which is a column of mercury. Choose a tube with a bore not exceeding one-eighth of an inch in diameter, in order to take advantage of the cohesive attraction of the mercury, which prevents its separating into small drops and falling to the bottom of the tube; if, now, the tube be raised suddenly, then, from the inertia of the mercury, the column of air is compressed, and if we keep the tube motionless, the compressed air will react on the mercury, which will then indicate every change of pressure in the column of the air.

It is considered, in what is called the wave theory of the atmosphere, that the point of greatest elevation, or crest of the air, corresponds to the highest reading of the barometer, and that the lowest point, or trough, corresponds to the least pressure. It must be borne in mind, however, that we are not considering the case of an incompressible liquid, but that of a compressible gas, varying from a state of extreme tenuity in its highest regions, to that state of elasticity which it exhibits at the earth's surface.

It follows, therefore, that if we start with an atmosphere free from all vibration, and that for simplicity we suppose a single impulse to be given to a column, the time between each oscillation would be uniform; and from examination of barometrical observations at this and other stations, it appears that there is a very frequent oscillation of about three and a-half days, that is from maximum to minimum pressure. We will neglect, for the present, the small horary variations so well established, which are also observable at this station, and take the barometrical tables for 1869, at Dunedin. The lowest pressure for the month of January (reduced) was 29·263 inches on the 20th; the highest being 30·252 on 23rd; while on the 26th it was down to 29·416. In the month of February, the barometer was at 29·689 on the 5th, and the highest reading for the month (and year) was 30·462 on the 8th; while three days subsequently, on the 11th, the pressure was 29·8. On the 20th, or nearly three vibrations afterwards, it was as high as 30·34; while on the 24th it was down to 29·417, which was the lowest for the month, and on the 27th it stood at 29·8 inches. In the month of March the pressure was 30·239 on the 20th, and 29·130 on the 24th, while it rose to 30·147 on the 28th. In April we have 29·89 on the 1st, and 30·430, the highest for the month (and near the highest for the year), on the 5th. Then 29·978 on the 9th; 30·223 on the 11th; and four days later, 29·142, being the lowest for the month, occurred on the 15th, while on the 18th it stood at 30·036. In May, 29·706 on the 16th, and 30·390, being the highest for the month, on the 20th, while the lowest for the month, and also for the year, namely, 29·027, occurred on the 24th, and on the 29th it rose to 30·031. In June, the highest reading for the

month was 30·370 on the 21st, and the lowest was 29·293 on the 30th, which will allow for three vibrations.

In July, on the 5th the pressure was 30·129 ; on the 7th it was at 29·376, which was at the lowest for the month, while on the 10th it rose to 30·123 ; on the 14th, instead of lowering, it rose to 30·304, which was the highest for the month, and the difference of time between the highest and lowest readings is in this case contradictory to the generality of the oscillations previously noted, their regularity being partly neutralized by others. In August, the pressure on the 7th was 30·069 ; on the 10th, 29·374, being the lowest for the month ; on the 14th, 30·131 ; on the 17th, 29·447 ; on the 19th and 20th, 30·23, which was the highest for the month ; on the 23rd, 29·937, when it commenced rising till the 25th. In September the lowest reading was 29·428 on the 2nd, and the highest 30·446 on the 19th, this interval would allow of five vibrations, while on the 24th the pressure was 29·695.

In October, on the 13th the pressure was 29·527, then on the 18th, 30·354, which was the highest for the month, while four days after we have the lowest for the month, 29·279 for the 22nd. Then, six days after that, which would allow of near two vibrations, the pressure was again as low as 29·466 on the 28th ; on the 31st it rose to nearly 30·2, and in this case continued to rise till it attained 30·328 on the 2nd November ; in which month the vibrations were irregular on the whole, but it may be remarked that on the 23rd the pressure was 29·727 ; on the 28th it sank lowest for the month—namely, 29·253 ; while on the 1st December it rose to 29·980, and then continued to rise slightly, but on the 5th it was down to 29·734 ; on the 8th it rose to 30·062 ; on the 13th down to 29·727, then on the 21st and 22nd up to the highest for the month—namely, 30·372 ; on the 25th down to 29·792 ; on the 27th up to 30·032, and on the 29th down to the lowest reading for the month, which was 29·553.

It may be interesting to mention a series of minimum barometrical readings recently taken, which, from their regularity as regards the time of their occurrence, sufficiently prove that the atmosphere is amenable to the general laws regulating the action of elastic media. On the morning of the 5th June, 1870, the reading was 29·392, when, after rising to 29·935 on the 7th, it again fell on the 12th to 29·250. The minimum oscillation is then apparently lost for the 19th, being probably neutralized by others, but it appears again on the 25th, the interval being one day less than that obtained between the previous oscillations, when we have a minimum reading of 29·164. It again appears on the 2nd and 3rd July, when the pressure was below 29·3. These oscillations have a large range, and must be considered as compounded with many others, which would affect the time and range.

It would be difficult to prove these oscillations to be the result of periodic changes either of temperature or winds, although their time and range must be modified thereby. It has been ascertained that there is less range of pres-

sure in proportion to the mean pressure at great altitudes than near the earth's surface. Referring to the Meteorological Statistics of the Colony, an abstract of which is given at the end of *Transactions of the New Zealand Institute*, Vol. ii., on "The Climate of New Zealand," it will be seen that the height of Bealey Station, above the sea level, is 2100 feet, and the barometrical range for 1869 is 1·132 inches, while the mean annual range at the other stations in the South Island is 1·4; and it will be found by dividing the mean observed pressure by the mean range, that the fluctuations of pressure are less at great altitudes. Complete observations at different altitudes near the same station are, however, yet wanting, which would throw light upon the manner in which the variations of pressure are communicated from lower to upper regions and *vice versa*. It is known also that the air is subject to different horizontal motions at different altitudes at the same time, where it would only be in a column of air which is perfectly stationary that the barometer at the bottom would give the absolute weight thereof at any given instant. That the barometer informs us of changes and expected changes of weather is generally conceded; superior pressure indicating fine weather, and low pressure the reverse. But what is the nature of the connection? When aqueous vapour is added to a given weight or column of dry air, that column must be so much heavier, why should not therefore the barometer rise?

Again, when the temperature of the air rises, which it often does before and during storms, why does not that increase of temperature keep the watery vapour in it from precipitating as rain? Again, chemists have succeeded in liquefying many gases by subjecting them to pressure. When, therefore, the atmospheric pressure increases, why should not its aqueous vapour (if at its point of maximum density) be precipitated as rainfall? With reference to the first question, when watery vapour is taken up into the air, why should not the barometer rise? It must be remembered that heat has accompanied the moisture in its evaporation, which leads to the expansion of the column beginning at the bottom; it is therefore a moving column upwards, in which case its absolute weight could not be given by the barometer, but only its pressure at the given instant.

It has been shown by Dové, that the warm moist air of the equatorial regions is in an expanded state, and would flow in the higher regions towards the poles; and since the equatorial regions of the earth revolve about 1000 miles per hour, while at the poles the motion is at the minimum, it follows that the currents of equatorial air in southing have a tendency to keep their easterly motion, and thus form a wind, which, in this latitude, would come from a north-westerly direction, often at a considerable height; whereas the cold polar currents, being continually left behind while passing towards the equator near the earth's surface, would reach us as a dry, cold, south-easterly wind.

It is therefore obvious that the oscillations above alluded to would have this effect:—the upward one would take the moist north-west currents, or portions of them, into higher and colder regions; the barometer falls, and there is a greater probability of rain. It would be different when the return or downward oscillation takes place, for then, according to this view, the upper strata of air are brought nearer to the earth's surface, where they gain in heat, and their watery vapour is consequently more likely to be held in suspension; the barometer rises, and fine weather generally occurs. It is remarkable, however, that some of our heavy rainfalls take place when the wind is south-east, possibly from its flowing under and lifting up moist and rare strata to greater heights, similar to the effect which a range of mountains has if extending across the route of moist winds. The air is compelled to rise to such a height that its watery vapour is quickly condensed, and falls as rain or snow. We have an instance of this in our own West Coast, where the rainfall is considerably more than on the East Coast, and this without any marked difference of pressure. Referring to the second question, why the increased temperature of the air (for the season) often observed before and during storms, does not keep its vapour from precipitating as rain? This increase is sometimes attributed to the latent heat of the aqueous vapour being made sensible when changed into liquid, but this would not account for the increase of heat which is observed before rain actually falls.

In fine bright weather, and especially under the influence of dry winds, the air must be storing up more aqueous vapour, and Professor Tyndall shows that the power of aqueous vapour to transmit heat rays of high refrangibility, but to absorb the less refrangible and obscure ones (such as terrestrial heat) situate beyond the red end of the light spectrum, is the chief and potent means of preventing the undue dissipation of terrestrial heat from the earth's surface. Moreover, the clouds which form before rain falls, and also when the pressure is low, prevent the radiation of terrestrial heat at night in a very marked degree. It may be therefore inferred, that the lowest stratum of air would rise in temperature as the aqueous vapour accumulated therein.

Referring now to the third anomaly—of many gases being liquefied by pressure, whereas increased atmospheric pressure generally indicates less probability of rain. The amount of pressure used by Faraday for the liquefaction of gases was sometimes as high as fifty atmospheres, and provision was made for the removal of the heat arising from compression. But the fluctuations of atmospheric pressure do not often exceed one-twentieth of the whole. Some bodies, however, are only retained in a liquid state by the atmospheric pressure. Alcohol and ether, for instance, if placed under the air-pump, commence boiling. Under the ordinary pressure, however, they still pass into the air, but by the slower process of evaporation from their surface. Water, also, if placed in a vacuum, fills it up at once to the point of its greatest density for

the given temperature; and, if the same vacuum be filled with air, though just the same amount of watery vapour would rise if the temperature is kept the same, yet it would take a considerable time. It follows, therefore, that the diffusibility of watery vapour is rendered much more rapid when the pressure of the air is reduced by its upward oscillations; it is taken more rapidly into the cold upper regions where it is condensed. It may be interesting to note the experiments of Dulong, which show that "equal volumes of all gaseous fluids, at the same temperature and pressure, on being suddenly compressed or dilated to any equal volumes, disengage or absorb the same amount of heat, and the amount of heat required to raise a gas to a certain temperature increases the more it is allowed to expand. If there be no source of heat from which this additional supply can be obtained, the gas is cooled." And there does not appear to be this source of heat in the highest regions of the atmosphere, where the air is rare, for its diathermancy if dry, as we must suppose it to be in these regions, allows of the transmission of the heat rays of the sun through it, no heat is absorbed by it, therefore none can be radiated, and we have already seen that terrestrial radiation is much diminished by passing upwards through the aqueous vapour near the earth's surface.

Referring once more to the miniature column of the atmosphere contained in the glass tube, if the air be heated it will expand, and if cooled it will contract, and conversely (from what Faraday terms "the Correlation of Physical Forces"); if it be mechanically compressed, its temperature rises, and if rarefied its temperature lowers. With suitable apparatus, the column could be made to show not only a reduction of temperature when mechanically expanded, but also a loss of transparency arising from partial condensation of its watery vapour.

Art. LVIII.—*Notes on the Chatham Islands and their Inhabitants.*

By Gilbert Mair.

[*Read before the Wellington Philosophical Society, November* 12, 1870.]

The Chatham Islanders, or Morioris, or, more correctly, Maiorioris, state that they came to the Chathams in five canoes, viz:—*Rangitane*, *Rangihona*, *Rangimata*, *Ruapuke*, and *Okahu*. They say that they came from the villages of Tahurimanuka and Wharepapa, at Hawai, whence they were driven by tribal quarrels; that upon their arrival at the Chathams they found the islands thickly populated by natives, differing very considerably from themselves.

There were two tribes of them,—the Rongomaitere and the Rongomaiwhenua. At first, and for some years after, they had numerous fights with these people, but they eventually made peace with each other, and by intermarriages became as one people.

They had been cannibals up to this time, but upon peace being made they renounced man-eating altogether, and when tribes or individuals had quarrels, they fought with light sticks, and the dispute was decided in favour of the party who drew first blood.

Unlike the New Zealanders, the Maiorioris have neither songs nor chants; but they have a sort of dance, in performing which they flourished short sticks round their heads.

One of their principal ancestors was named Kahu, the captain of the canoe *Okahu.*

Their modes of disposing of the dead were peculiar. In some instances the corpses were placed upright between young trees, and then firmly bound round with vines, and in course of time they became embedded in the wood itself; sometimes they were placed in hollow trees. Several skeletons have lately been discovered by Europeans, in trees which they were cutting up for firewood, etc. In other cases the corpses were placed on small rafts constructed of the dry flower stems of the flax; water, food, fishing lines, etc., were then placed by them, and they were set adrift and carried out to sea by the land breeze. Not long ago an American whaler discovered one of these rafts with a corpse seated in the stern, many miles from land. Not knowing that it had been sent adrift purposely, the captain had a rope attached to it, and towed it into Whangaroa Harbour, much to the annoyance of the natives.

An old sealer, Jack Coffee, who has been living at the Chathams since 1832, informed me that he found the Maiorioris very numerous when he first went there, and that on one occasion he counted over a thousand men on the beach going to Waitangi. He was on the Island when the Ngatiawa and Ngatimutunga went down from New Zealand. He says they treated the inoffensive Maiorioris with great cruelty, but not so barbarously as is generally supposed. They killed and ate great numbers because they would not submit, but fled to the woods, from whence they issued occasionally to steal the crops and to break the canoes of their conquerors. For these petty acts of retaliative aggression, the offenders who happened to be caught were killed and eaten.

When the Maiorioris entirely submitted to the rule of their conquerors, they were treated with much more consideration.

In 1839, an epidemic carried off great numbers of the Maiorioris, sometimes as many as forty dying in a single day.

This epidemic was, no doubt, identical with the great plague of influenza which, in the same year, committed such ravages in New Zealand. Probably one-half of the Maiorioris died from this cause; a third, perhaps, were slain by the cruel Ngatiawa and Ngatimutunga; and thus the rapid diminution of the unfortunate Chatham Islanders may be accounted for.

The foregoing notes may hereafter be found incorrect in some respects as

I only had an opportunity of conversing with two or three old men, who did not seem to know much, and referred me to others who, they said, could give me a great deal of information respecting their early history, and could count back more generations than the New Zealanders.

I think that very much remains to be collected concerning this most interesting race, which is rapidly becoming extinct.

[Mr. W. L. Buller, F.L.S.. who visited the Chatham Islands in 1855, informs me that the author has omitted all reference to an important circumstance connected with the conquest of the early Maiorioris, and accounting in some measure for the rapid extinction of the race, the particulars of which will be found recorded in a pamphlet published by Dr. Dieffenbach, which is now very rare.—Ed.]

Art. LIX.—*On the Analogy between the Maori and Indo-European Languages.* By Edwin Fairburn.

(abstract.)

[*Read before the Auckland Institute, October* 10, 1870.]

The present paper will consist chiefly of a comparison of words. Before proceeding, I would, however, point out certain resemblances of grammatical structure which the Maori bears to the Indo-European languages.

1st. The resemblance of the Maori definite and indefinite articles respectively to the English, as *he* = *a*, *te* = *the*. Also, of particles forming cases, as *o* and *a* = *of*, identical with *o* and *a*, the Old English form of *of*; also, the particle *ko* (interchangeable with *to*) sometimes used in Maori for the dative *to*.

2nd. The formation of substantives from verbs in Maori by the addition of *nga*, *hanga*, *tanga*, *ranga*, etc., resembling the English *ing* and German *ung*, by which the same process is effected in the same manner.

3rd. The formation of the present participle by the addition of *ana* to the verb, resembling the Sanskrit *ana* of the middle voice, the Latin *ans*, and the English *ing*, etc., applied similarly to form the present participle.

4th. The superlative is formed in Maori by prefixing *tino*, "*very, exceeding*," to the adjective; in Latin by affixing *timu*, in Zend *tema*, and in Sanskrit *tama*.

5th. In most Maori verbs the perfect tense coincides with the imperative and passive, which last two are always identical; but when the perfect does not so coincide, it is formed by a reduplication of the first syllable, as—imperative, *taari-a*, "*wait;*" perfect, *kua tatári ia*, "*he has waited;*" resembling a similar reduplication in the Greek and Sanskrit perfects.

In the preceding example, the particle *kua* helps to form the perfect. German has a similar particle, *ge*, prefixed to form the perfect.

6th. In Maori, the past participle is formed by adding *tia, ria, kia*, etc., to the verb, resembling the similar terminations in English, German, Latin, etc., in *d, t, atus, etus*, etc.

7th. In Maori, ordinal numerals are formed by prefixing to the cardinals *tua*, which originally, no doubt, meant *number* (from the same root as *tátau, to count*), as proved by its equivalent in Samoan, *toa*, meaning also in that dialect, *number*.

In Sanskrit, ordinals are formed by affixing the superlative form *tama*, or modifications of it, to the cardinals. The same principle is observed in the other Indo-European languages, as—Greek *to*, Latin *tu*, Gothic and Anglo-Saxon *ta*, and English *th*. Now, as the superlative degree really carries the essential idea of *number*, it is very probable that the Sanskrit *tama* and the other forms adduced were originally derived from a root signifying number; very likely the identical one from which the Maori *tua* and Samoan *toa* are derived.

These are the principal points. Many more minor ones might be brought forward, but the doing so would take too much space.

The Maori, I believe, will be found upon examination also to contain many old Egyptian and Arabic words, and I think it is a mistake to class it as belonging to the Turanian group of languages. It is rather a mixture of the Indo-European and Semitic.

The very name Maori points most significantly to the stock from which the race has been derived. This idea first struck me about seven years ago, and a friend of mine lately, without knowing the fact, stated that some time back the same thought had also occurred to him. Lately, after reading books of ancient travels, voyages, etc., I am almost confirmed in the opinion that the names *Maori* of New Zealand, *Mori-ori* of the Chatham Islands, *Malay* (more properly *Malai*), etc., etc., are but modifications of the same word as *Moor* in English, and the *Mauri* of the Romans;—those *Mauri* who carried into Spain the words like Maori, quoted in *Thompson's Story of New Zealand*.

I am not quite sure, but I believe that the name *Malay* is supposed to be connected with *Malacca*, But I think *Malacca*, or *Malaka*, simply means *east*. *Marangai* means east in Maori, named so, no doubt, from its being the quarter of the sun's rising—*áranga* means *rising*, and *maránga* means *to arise*; this would be pronounced *maráka* in some parts of New Zealand, almost identical with the name of the Malayan Peninsula. The Maori is the same fierce cross between the Arab and Ethiopian that the Moor was, with a further modification in the shape of the ancient Persian element.

Philologists have been puzzled to account for the name *Moors* being applied to the languages of the southern coasts of Asia, but I believe the true explanation is the foregoing one, and that there has been nothing arbitrary in the matter. It is simply the voice of tradition that has been followed.

[This paper was supplemented by lists of words showing the relation between the Maori and the Sanskrit, English, German, Greek, Latin, and Moorish languages, and the author makes the following concluding remarks]:—

Having furnished the foregoing comparison, I would only observe further that I believe a comprehensive study of the Polynesian dialects, and especially of the Maori (which, from natural causes, I think has been the most conservative of them all), will throw a light even on many of what are considered pure English etymologies. The first step in such a study should be a careful and cautious inter-comparison of the different dialects, so as to recover forms which some had lost and others retained, and also, where the forms varied to decide by weight of votes upon a standard of antiquity.

It is a fortunate circumstance for the comparative philologist that the people speaking the Polynesian language have been so long scattered and efficiently isolated. It partly makes up for the want of the written records which enable the study of the European languages to be made with such certainty.

ART. LX.—*On an Adaptation of Water Power.* By J. C. CRAWFORD, F.G.S.

[*Read before the Wellington Philosophical Society, August* 20, 1870.]

As lately I was anxious to ascertain if I could command a sufficient water power for working flax, and finding that, in the opinion of competent persons, the supply of water in the proposed locality was insufficient, it struck me that if advantage should be taken of the wind power to be obtained in pumping up water, day and night, on Sundays and holidays, into a reservoir sufficiently elevated, an auxiliary head of water might be obtained sufficient for the power required. I mentioned this idea to persons skilled in machinery, but did not receive encouragement. It was, therefore, with some satisfaction that I found the following information on the subject in the May number of the *Country Gentleman's Magazine* for the present year.

"In a recent article we gave a few remarks upon water power, with special reference to the turbine, an appliance which would, in many instances, be specially useful on a farm where no great extent of power is generally required. Thus, in many farms a power equal to that of two horses, or even less, would be of great use in cutting straw, grinding meal, pulping roots, and the like. Now, a very small and cheap turbine would give out this amount of power. Of course, a supply of water with some height of fall is necessary, but where the fall is not attainable by the natural position of the ground upon which the farm is built, it might be worth while to consider a mode of working very frequently adopted in America. This method consists in erecting a windmill, which is so arranged as to be self-acting, always turning to the direction of the wind, and thus ready to act at all times when the wind blows

with force sufficient to overcome the work to be done. To the shaft of the mill a force-pump is connected, and this pumps up the water to a reservoir placed at a certain altitude. A supply of water at pressure is thus obtained, which is found very useful on the farm for various purposes; and, having a certain head upon it, it is invaluable for the extinction of fires. Now, if this arrangement was in use, the water thus under pressure might be arranged to be sufficient to work a small turbine, or a small water pressure engine. The power thus obtained, would be obtained at a comparatively small cost; there is no expense in keeping it up, as in the case of a steam engine; the only expense would be in keeping the apparatus in repair, which would not be much, as at the slow speed with which the work would be done there would be comparatively little wear and tear. True, the power of the windmill would be intermittent, in calm days not working at all; but by storing up the water, which it would pump up in an elevated reservoir, the power would be available at any time, through the intervention of the turbine."

I think the above extract is likely to give New Zealand settlers a valuable hint as to a mode of supplementing a limited water power without the necessity of going to the expense of purchasing a steam engine, and afterwards maintaining it, at a great annual charge for fuel and management.

It may be said, why not apply the wind power direct? The reply is obvious. The wind power is not a steady power, and for working flax, machinery driven by it might be standing still for days together, with the "hands" engaged standing idly by.

In the depressed state of the flax industry, it is desirable that we should study every economy in the production of the fibre.

Art. LXI.—*On the Use of the Semicircular Protractor, with a Description of an Improved Form of that Instrument.* By James Stewart, C.E., Assoc. Inst. C.E.

[*Read before the Auckland Institute, November 7, 1870.*]

Any method by which a series of lines forming given angles with each other, or bearings with the meridian, can be expeditiously and accurately plotted, ought to be of interest to many besides the professional surveyor or draughtsman. It is presumed that this will be granted so readily, that the writer deems it unnecessary to apologize for bringing before the Institute a subject of apparent professional detail, or to enumerate the pursuits, in facilitating which the Semicircular Protractor can materially assist.

So far as the writer knows, the protractors in almost universal use are circular, and are either of lithographed paper or more elaborate instruments of brass. In either case the method of using them is the same. The instrument is fixed down on the drawing paper, and all the bearings required are marked

off diametrically, and subsequently run into their positions with a good parallel ruler. The inconvenience of this method is not much felt in plotting compact surveys, although even in such cases the use of the Semicircular Protractor confers great advantages; but in the case of long and narrow surveys, such as railway work almost always presents, the inconvenience and liability to error attending the use of the circular instrument is such that the other method seems, in comparison, perfect.

For about eight years the writer used, as occasion required, the old method, and then determined to adapt to more extended use than its inventor seemed to have intended the instrument described by Mr. Howlett, as quoted in Heather's *Treatise on Mathematical Instruments*, in Weale's well known series. Several alterations, however, from Mr. Howlett's design suggested themselves, and the improved protractor was made by Messrs. Elliott Brothers, of London, from drawings supplied by the writer, and its use by him for the last eleven years, in every variety of work, has demonstrated its great superiority over the old method—in points of accuracy, comfort in using, rapidity with which work can be laid down, and the great facility which it offers in tracing the occurrence of any error in plotting.

Mr. Howlett fastened the drawing paper to a board, and used a T square, whose edge represented the meridian, hence any angle to which the arm of the protractor was set could at once be transferred to any position on the paper, by keeping its meridional edge in contact with the square, and moving both on the paper until one edge of the arm coincided with the point required. But long rolls of paper cannot be used with a T square or drawing board, and the writer uses in such cases the same parallel ruler which is required in using the circular protractor. If the work lies mainly north and south, one meridian line is drawn in lightly in blue; if it lies otherwise, several meridian lines may be required at various intervals, laid down with great care. The edge of the heavy brass parallel ruler, then, represents the meridian, and its truth can be compared with the nearest line at any moment. The protractor is moved along the edge of the ruler until in position, just as with the use of the T square. Of course, when the size of the map or plan is such as to admit of the paper being fastened on a board, the T square forms the most perfect parallel ruler, and should be used in preference.

The operations which must be gone through when using the circular protractor—consisting of laying down the bearings, reading off the particular one required (sometimes among a crowd of others of nearly the same angle), setting the ruler, and running it into place—may, by the method here advocated, be said to be comprised in one movement, such is the comparative and absolute ease attending its use.

While setting the vernier arm, the instrument is held in the hand, and in the most suitable light. This, besides being a source of much comfort, is

conducive to accuracy, such as is seldom attained by any other method. Those who are accustomed to examine the accuracy of plotted traverses will appreciate, without further remarks, a method by which any bearing may be checked at a glance, and each traverse followed out with great rapidity and accuracy with no more preliminary work than ruling one or more meridian lines.

Two forms of this instrument have hitherto been made — Howlett's (mentioned above) and Metcalf's—but neither seem to the writer to present simplicity and compactness enough for general use, while, in both, the vernier is set at an angle of about 30 degrees with the plane of the graduation, causing great disturbance of light and shade, and, in part, sacrificing one advantage of the system.

In the instrument designed by the writer, [a drawing of which was exhibited at the meeting] the vernier is in the same plane as the graduated limb, and is distinct from the arm, working on the latter in dovetailed grooves, and held to the limb by a light spring; the arm is parallel in the sides from the centre joint to the extremity, excepting only the part embracing the the graduated limb and vernier, which part is reduced to the smallest and most compact dimensions. In deference to the custom on all protractors, the centre is transparent, and means provided by which a line truly radial with the centre may be marked off, but simple angles may be easier laid down, precisely as bearings, using, for the sake of handiness, an ordinary short parallel ruler.

No doubt very much lies in habit, but as the writer has given both methods fair and extended trials, he feels justified in awarding the special advantages above named to the instrument which, under the same circumstances, has enabled him to perform work the most satisfactory in all points of view.

Art. LXII.—*On the Use of Salt Water in the Field Boiler.*

By James Stewart, Assoc. Inst. C.E.

[*Read before the Auckland Institute, July* 11, 1870.]

Among all the numerous inventions and improvements in steam boilers which have been brought out in late years, none seem to promise better results than that known as the "Field" Boiler, from the name of the inventor. This boiler gives a surprising amount of steam, and belongs to the class having water tubes. The invention, however, lies only in the tubes, and they may be applied to almost any sort of boiler now in use. The best results are likely to be obtained nevertheless from boilers specially designed for "Field" tubes. So far, with the use of fresh water, nothing more seemed to be desired, but it very soon came to be a question, with the writer and others, whether or not they could be worked with sea water. If with its use, incrustations to any

extent at all were formed within the tubes, they could not be used without risk and trouble far outweighing their advantages. Consideration of the fact that the "Field" tubes owe their value solely to an ingenious device for promoting to the utmost the circulation of the water, and also, seeing that wherever in common boilers circulation is more than ordinarily active, very little, and sometimes no incrustation with salt or lime takes place, there seemed good reason to expect that the new tubes could also be worked at sea. But under what circumstances? with what density of water? and whether or not any scale at all was formed, no specific information could be gathered. The writer then determined to institute an experiment, which, with the co-operation of Mr. R. H. Yeoman, Boiler Maker, Auckland, he was enabled to carry to a satisfactory conclusion, and of which the following is a brief record.

As the principle of the "Field" tubes is probably unknown to many of those unacquainted with steam power, its action may be shortly described, if we conceive a tube open at the upper end, and closed at the lower, passing through, and suspended from, the crown of the furnace or flue of any boiler. An inner tube, *open at both ends*, and about half the diameter of the outer one, is suspended and steadied by small ribs or *feathers*, so as to be clear of the bottom about twice its own diameter, and project a little way at the top, above the tube plate, *but terminating below the water level;* it is "bell-mouthed" at the upper end.

On the application of heat, the water in the annular space between the tubes is the first to be affected, and at once begins to rise, its place being taken by the cooler water from above, descending through the inner tube. This circulation, as the heat is continued goes on increasing, until, on the formation of steam in the annular space, it is enormously increased, owing to the very great difference in specific gravity between steam, and water even at the boiling point.

The experimental boiler was originally intended by Mr. Yeoman to show visibly the effect of the circulating tubes, which it very clearly did, being, for this purpose, at first uncovered at the upper end. It had seven tubes, about 2 inches diameter and about 1 foot 6 inches long; internal tubes 1 inch diameter, but their funnel mouths were not of the most effectual shape. For the purposes of experiment, this boiler was covered in, and fitted with blow-off cock, gauge glass, and safety valve, and the water was supplied by a force pump.

The duration of the experiment was three weeks, the boiler being regularly attented during working hours; and the pressure of steam and density of water kept nearly uniform to the extent required. The salinometer, by which the density of water was regulated, was first carefully tested for accuracy, and the amount of solid matter in the sea water used ascertained by evaporation. This was found to be 5½ ozs. per gallon.

During the first week of the experiment, the pressure was not worked at

more than 15 lbs. per square inch, and the density of water about 16 ozs. per gallon;—this is about double the density used in many marine boilers. During the latter two weeks, the pressure was maintained at 30 lbs. per square inch, and the density at 21 to 23 ozs. to the gallon, or what is commonly expressed as $\frac{4}{32}$, that ratio expressing the weight of solid matter to that of the water. Ordinary marine boilers could not be worked many days at this density without being totally ruined, and a very few hours would suffice to allow a thick scale to be formed all over the heating surface. Very few of our coasting steamers are worked with water over $\frac{2}{32}$, or about 10 ozs. to the gallon. About 200 gallons of sea water were evaporated, and thus over 1000 ozs. of solid matter were passed through the tubes. Under all the circumstances, it was never expected to find the tubes entirely free from scale, yet, on examination, they were found to be so, with the exception of one part of each; and this exception may be looked upon as the most valuable part of the results, showing clearly, as it did, that it was to circulation of water alone that the perfectly clean state of the tubes could be attributed. In this instance, the inner tube instead of being suspended clear of the bottom of the outer one is resting on it, and the passage of water provided for by two apertures on opposite sides. Hence the currents of water at the lower end were confined to the parts opposite these holes. On the other parts, a solid brown incrustation of salt and lime had formed, sufficient to cement the tubes together, and requiring some little force to separate them. The scale was rather less than one-eighth of an inch thick, and extended about one inch up the blank ends of the inner tubes.

To all who witnessed the experiment, no result could have been more conclusive other than that of *actual trial for a considerable period at sea*, and the writer is convinced that, with well-arranged proportions, the "Field" boiler can be worked at sea with at least equal facility with the best design of common tubular boilers, and certainly with very much more ease and safety than with numbers of those in common use.

The experience of the writer leads to the following as the principal points to be attended to in designing "Field" boilers. The tubes should be long and few, rather than short and numerous; the lower ends should be hemispherical, and not flat; the upper ends of the inner tubes should be carefully opened out to a circular curve (more correctly a parabolic one), instead of the flat funnel mouth mostly used; and the flame and hot currents should be made to circulate perfectly around the pendant tubes.

It is found to be of the very greatest importance that water free from vegetable matter should be used in these boilers, as the slightest concentration of such causes, with the rapid circulation, determined cases of priming, and has been known to choke the inner tubes when allowed to go too far.

Art. LXIII.—*On a Self-acting Clamp Mountain Wire Tramway.*

By F. W. Wright, L.M.B. Toronto.

(Abstract.)

[Read before the Auckland Institute, August 8, 1870.]

This is a proposed modification of the wire tramway in use on the Thames gold field, for which a patent is being sought by the inventors—the author of the paper and Mr. Herrich, of Parnell.

The principal points in this new arrangement of mountain tramway, which particularly distinguish it from all methods heretofore brought into operation, are the following:—The load is suspended underneath a travelling endless wire by a self-acting clamp of the patentee's invention, which grasps the wire the more tightly the weight is increased, and, as the suspending rod is provided with a universal joint, the load finds its proper centre of gravity without straining the wire, and these clamps embracing the travelling wire, are so adapted to the grooved rollers over which they run, as to enable them to pass with facility. With regard to the arrangement for encircling sharp curves, there is a provision which enables the load to leave the wire, and a properly grooved pulley, underneath the hook, runs with the load on to a rail or supplementary guide rod, placed so as to cut off the awkward angles. Immediately the pulley or roller takes the weight on the branch line, the self-acting clamps relax their hold of the main line or wire, and as soon as it runs off the subsidiary line they again seize the chief wire, and the box or carriage runs on as before. A similar provision is made at the starting and discharging points, and by the simple device of raising one part of the wire slightly, so as to catch the pulley at a certain part of the incline, the load must necessarily leave the main line and run on the grooved pulley, until a corresponding decline again enables the clamps to catch hold of the traversing wire. Of course, the junction of trucks from branch lines can be managed in the same manner.

Again, when it is requisite to traverse any country of a peculiarly irregular character, power of any description can be applied to a driving wheel, and the surplus of this power, as well as that which is gained by the descent of the full boxes, can be utilized in moving pumping or ventilating apparatus, winding gear, separation of tailings by an endless screen, or the general work of a crushing machine, and a break can be attached so as to stop the wire at any moment.

It will be seen, also, that by the addition of a suspension rod, the cross beams which support the wire can be made of much lighter material than usual.

Passenger cars can also be attached to the line, and the inventor has designed one of a safe and convenient description.

A line of telegraph can be carried along the posts without any great increase of expenditure.

Besides all these unusual recommendations, the boxes are so constructed as to enable them to be locked at the point of departure, so as to prevent the introduction of any foreign substances of a deleterious kind while *in transitu*, and by a simple self-acting contrivance, the load will be shot out on its arrival at the battery, and a self-acting weighing machine will be attached to the last post, by which the weight of the load can be correctly read off.

Last, but not least, of the proposed advantages:—A grip has been contrived by Mr. Herrich to grasp the wire at any moment, to prevent accident by the sudden fracture of the line; should a fracture occur, the natural inclination of the line would be stopped by the grip revolving upon the roller on which the wire travels, and holds it firmly jammed.

With these advantages, and the additional fact that it is believed the line can be constructed at an average cost of £800 per mile, it must be evident that the mining community would reap advantages from adopting this scheme, which would infuse new life into its proceedings, and would resuscitate many moribund companies which are being wound up, simply in consequence of their inability to obtain carriage at a reasonable cost.

The principle may be utilized for uniting any distant part of the country, instead of a railway, say between Riverhead and Helensville, a distance of sixteen miles, which could be constructed at a moderate calculation, including motor power, for about £10,000; the cost of a railway line of 3 ft. 6 in. gauge would be £50,000, not including rolling stock.

Art. LXIV.—*On the Currents, Temperature, and Saltness of the Ocean.*

By W. B. Bray.

(Abstract.)

[*Read before the Philosophical Institute of Canterbury, May 4, 1870.*]

The author of this paper after describing at length the principles which have been established respecting the distribution of ocean currents in the Northern Hemisphere, where they have been most fully studied, proceeds with the discussion of the currents in the southern seas:—

The Southern Hemisphere, in its geographical circumstances, contrasts so remarkably with the Northern, that very material differences may be expected in the currents themselves; yet the general principles are the same, in that the effect of intense polar cold produces a descending cold current, which flows along the bed of the ocean towards the equator, and draws a corresponding supply of warmer water to the pole, and the action of that warm current on the ice produces a superficial current of cold, but fresher, water from the polar ice.

In the north, the great continents approach within 15 or 20 degrees of the

pole, enclosing a vast ocean of unknown depth, which receives the rivers that drain one-fourth part of those continents, and which form the belt of ice intervening between the coast and the open ocean.

In the south, on the contrary, only Cape Horn comes within 24 degrees of the pole, about as distant as Ireland from the north, while the other continents of Africa and Australia are nearly as far from the south pole as the north coast of Africa is from the north pole.

A wide belt of ocean intervenes between the south capes of these continents and the polar ice, which encloses the Antarctic continent so closely that the coast has been only partially traced through a distance of 1500 miles, and its form and extent is still a matter of conjecture.

The peculiarly lofty barrier of Antarctic ice could not be formed by the freezing of ocean waters, but by the streams of water flowing from the sunny slopes of the elevated continent during the short summer, and forming plains of ice, resembling the plains of gravel and alluvial soil left by the rivers in warmer latitudes. During the height of summer, these streams may pour down the icy cliffs, but in February, the thermometer being at 14° at noon, these streams had formed the gigantic icicles seen by Sir J. Ross.

From the great height and inaccessible nature of this barrier, we can gain no positive knowledge of this hidden continent. But if any future Antarctic expedition were provided with a balloon of moderate size, and 200 or 300 fathoms of silk cord, some one might ascend from a boat to such an elevation as to have a clear view over these frozen plains to the mountains beyond, which are concealed from the view of those on shipboard.

The intense cold of the Antarctic winter, acting on the surface of the deep sea around this continent, will produce descending currents of cold water, which will form under currents receding from the pole in the deepest portions of the ocean bed. In one place Sir J. Ross sounded 4000 fathoms, and found no bottom; and the Austrian expedition, in the "Novara," sounded 6170 fathoms, or 7 miles, without finding bottom.

But when this deep current meets with the obstruction of an island, or south cape of a continent, it must ascend to the surface.

The south side of the Crozets is generally hidden by thick fog, from this cold uprising water condensing the moisture in the atmosphere.

On the S.W. coast of Africa, Sir J. Ross found a cold current setting north, extending 60 or 70 miles from the coast.

The cold current also rises on the east coast of Patagonia, where it forms a northerly current inshore.

This cold current, rising at the south end of New Zealand, is probably the cause of the sea being only 51° or 52° at midsummer, when about Banks' Peninsula it is 58° to 60°.*

* For Temperature of Sea round New Zealand, see Report by Dr. Hector, *App. to Journ. H. of R.*, 1869, D. 2, p. 22.—Ed.

The deeper warm current is shown by the observations of Sir J. Ross, who found that while the surface water was 28° or 30°, at 400 to 600 fathoms the water was nearly 40°.

This deep and warmer current impinging on the barrier ice, undermines it, and by dissolving the ice, becomes fresher and lighter, and, rising to the surface, forms a superficial current which recedes from the pole, carrying with it the icebergs formed by fragments of the great barrier. Some of these are stated to be 600 feet high, in which case there must have been 4000 or 5000 feet below the water. Such enormous bergs might be formed by the fall of portions of the barrier, half a mile or three quarters of a mile long, which would float with the heaviest end down. These bergs are stated by Wilkes to advance 70 or 80 miles northward in one season. The cold and fresher current as it recedes from the pole must extend over a wider circle, and therefore diminish in depth. Icebergs floating partly in the upper current and partly in the lower, will be carried to such a distance, that the pressure of the two currents shall balance each other; then, their further progress being arrested, they will form that close pack of icebergs and floe ice, through which Sir J. Ross had to bore his way, while south of this pack he found a clear open sea, free of ice.

Art. LXV.—*Notes on the Conduction of Electricity.* By James Duigan.

(Abstract.)

[*Read before the Wellington Philosophical Society, July* 16, 1870.]

The object of this paper is to controvert a view stated in a paper entitled "The earth of New Zealand a bad Conductor of Electricity, as compared with that of other countries, by F. E. Wright," in *Transactions of the New Zealand Institute*, Vol. ii., pp. 226–227. The transmission of electrical currents along the telegraph wires, in some cases after they have become detached from the insulators, and lie on the ground, attributed by Mr. Wright to a peculiarity in the New Zealand soil or rock formation, is explained by the fact of the New Zealand telegraphs being worked on what is technically known as the "open circuit" system, one of the conditions of such system being, that it never occurs to have more than one battery sending its current of electricity along the line at the same time, whereas in Australia the lines are, or at least were, until very recently, worked on the converse of the "open circuit," viz., the "closed circuit," one of the conditions of this latter system being that there are a plurality of batteries always sending their currents along the whole length of the line, in their respective circuits, and which by so doing prevent a current passing beyond an earth-fault, thus closing the communication between all stations situated on opposite sides of the fault.

After explaining at length the nature of the two methods of working the telegraph, the author concludes by expressing his opinion that the term,

conductor, as applied to the earth in relation to battery currents, is a misnomer. The popular theory is, that if the two poles of a battery be put to earth, at no matter what distance apart—be it but one foot or one thousand miles—that the current flows over the wire from the copper pole of the battery to the earth back through the earth, coming up at the zinc pole through the earth, thus completing the circuit. This is not, however, what actually takes place, as the current which leaves the line at the earth, on the copper side of the battery, is taken into the common stock of electricity (of which the earth is a vast reservoir) at that point, and that the current taken up at the earth plate, on the zinc side of the battery, is in like manner derived.

Art. LXVI.—*Notes on a Paper "On Sinking Funds," read by Captain Hutton before the Auckland Institute, September* 7, 1868. (Trans. N. Z. Inst., *Vol.* ii., *p.* 236.) By J. S. Webbe.

(Abstract.)

[*Read before the Otago Institute.*]

The object of Captain Hutton's paper is to discover, by mathematical investigation, whether it is better to invest a sinking fund in the loan which it is intended to pay off, or in other securities. A man of business would not take much time to answer so simple a question. It is quite unnecessary to go to the trouble of calculation to discover—what Captain Hutton has done at the end of his paper—that it is profitable to borrow at a low rate of interest and lend at a high one, and that the longer the time this is done the greater will be the profit; for that is precisely what he means when he says that, "the smaller the sinking fund and the higher the rate of interest, the greater will be the saving effected."

On the main question raised by Captain Hutton, it may suffice to remark that the great advantage of using a sinking fund to buy in an annual instalment of the loan to which it belongs, lies in the certainty of securing its fructification at the same rate of interest as the State is paying for that lóan. It is, therefore, matter for congratulation that the safer plan has been adopted in the case of the "Consolidated Loan Act, 1867."

[Errata *in Captain Hutton's paper*, Vol. ii. *of the "Transactions."*

Page 237, line 1, for "brought" read "bought."

" 237, " 26, for "log p v" read "— log p v."

" 238, " 14, for "T 1" read "T — 1.".—Ed.]

Art. LXVII.—*On the Changes effected in the Natural Features of a New Country by the Introduction of Civilized Races.* By W. T. L. Travers, F.L.S.

(PART III.)

[*Abstract of Lecture delivered at the Colonial Museum, Wellington, August* 27, 1870.]

After shortly recapitulating the points noticed in his two former lectures, printed in Vol. ii. of the *Transactions of the New Zealand Institute*, the lecturer proceeded as follows :—

When left to themselves, the natural forces which regulate organic life tend to counterbalance each other, and all life is by degrees brought to a condition of nice equilibrium, check and countercheck being most admirably applied. But the direction of these forces is changed, and the equilibrium arrived at disturbed, with more or less violence, when man appears as an actor in the scene, the amount of disturbance being, as I have already shown, affected chiefly by the character in which he appears, and usually being greater in proportion to his own advance in civilization.

These islands, indeed, afford us a most pregnant instance of my views on this point, as I now propose to show by reference to what has already occurred and what is constantly taking place under our own eyes, in the direction of modifying and displacing the life native to the soil. Let it be remembered, in this connection, that when civilized man transplants himself to a new country he carries with him a special knowledge of the value of a certain number of organisms, which have been gradually brought into subservience to his wants in the country which he formerly inhabited, whilst, in all probability, he is absolutely, or at least greatly, ignorant of the uses or value of the natural productions of his newly-adopted home. Moreover, his own necessities demand that he should, without any delay, introduce such of the productions of his former home as are most suited to his wants and offer the best prospects of succeeding in his new country, having regard to its climate and soil. He has at this period of active settlement no time to study the value or character of the organic life which he finds there, and accordingly he proceeds at once to bring land under cultivation, to sow it with the seeds of plants previously foreign to the soil, and to introduce such domestic animals as are most useful to him, either in the way of food or for purposes of labour.

In the struggle which he is thenceforth destined to carry on as a colonist, he becomes, as a rule, more and more careless of the native productions, unless they present some prospect of being immediately and directly profitable. The native timber is used for building and fencing, and in some few instances becomes an article of commerce ; but, as a rule, the forest stands in the way, and is recklessly and improvidently burnt or otherwise destroyed, without regard either to the immediate effects which such destruction may produce

upon climate, or to the certain injury which must be inflicted upon posterity. The native grasses are temporarily utilized for feeding sheep and cattle, but little attention is paid to their feeding values or to the probability of bringing them, either alone or mixed with exotic grasses, into that condition of cultivation in which they may become permanently valuable or be made to yield the largest return.

In these islands we have already seen this course taken, and those who look beyond the present, cannot but be struck with the immense direct injury which has already resulted from the indiscriminate and reckless destruction of the forest and of many other of the natural productions. As a pregnant example, bearing upon this point, I may take the instance of the *Phormium tenax*, which, for nearly thirty years, has been destroyed to a greater or less extent in every part of the country. I have seen thousands of acres of this plant, of a growth which would yield nearly a ton and a half of pure fibre per acre under any fair system of manufacture, burnt recklessly for the purpose of substituting grass; and I have seen the land upon which the flax plant had stood in its greatest luxuriance, so injured by the fire which was used for clearing it, as to be unfit for the production of any other crop except at an outlay for which no adequate compensation could be obtained.

Our large rivers, which most colonists remember as inflicting, in former days, but little injury to the valleys and plains through which they flow, have now in most instances become raging torrents, against whose injurious effects we are called upon to guard by expensive and difficult engineering works. We may trace the course of this change to precisely the same violation of natural laws which has brought about similar results in other countries. There, as here, when the forest has been destroyed, the moisture long stored up in its mould is evaporated, and returns in deluges of rain, which wash away the dried soil into which the accumulated mass of mould has been converted. The water-courses become choked and encumbered with the debris, and the country which had previously presented an appearance of rich vegetation is converted into bald hills and dessicated plains, liable to be still further damaged by the ravages of the intersecting streams. There can be no doubt that this process is now going on in many parts of these islands, and we have seen, during the last two or three sessions of the Legislature, measures introduced for the purpose of checking the growing mischief.

We are told by a distinguished author, "that there are parts of Asia Minor, of Northern Africa, of Greece, and even of Alpine Europe, where the operation of causes set in action by man (causes precisely similar in character to those which have been recklessly set in action in this colony), has brought the face of the earth to a desolation almost as complete as that of the moon; and within that brief space of time which we call 'the historical epoch,' they are known to have been covered with luxuriant woods, verdant pastures, and

fertile meadows, they are now too far deteriorated to be reclaimable by man, or to become again fitted for human use, except through great geological changes or other influences or agencies of which we have no present knowledge, and over which we have no prospective control." The same author without hesitation affirms, and a careful study of the question as it affects many parts of the world, leads to a perfect acceptance of his views, that "the earth is fast becoming an unfit home for its noblest inhabitant, and that another era of equal human crime and human improvidence and of like duration with that through which traces of that crime and that improvidence extend, would reduce it to such a condition of impoverished productiveness, of shattered surface, and of climatic excess, as to threaten the degradation, barbarism, and, perhaps, even extinction of the species."

This is strong language, but I may confidently appeal to any of those who have visited the plains of Babylon and Nineveh, and those parts of Judea, once described, and truly described, as flowing with milk and honey, and now converted into a howling desolation, in confirmation of their absolute truth. I may be told that these are evidences of God's wrath against the people who inhabited those countries; but setting aside all questions of controversy as to whether the Great Author of Nature ever so deals with man as intentionally and mischievously to interfere with the conditions of life, it is clear that it is to man's action, as a primary cause, that we may attribute the misery and desolation to which they are now reduced—and as a proof of this, let me cite an instance in very modern times of the class of mischief to which I have alluded, and one which bears very directly upon the line of action pursued in various parts of these islands.

[The lecturer here quoted descriptions of the devastations caused by floods in the Alps of Provence and other parts of France, as described by Blanqui, Surell, and others.]

What a picture of evils have we here! And yet in this country, with similar results staring us in the face, we still persist in the course which has led to them.

One of the authors from whom I have quoted, however, guards himself from any charge of rash and unphilosophical attempts either to set limits to the ultimate power of man over inorganic nature, or to speculate as to what may be accomplished by the discovery of now unknown and unimagined forces, or even by the invention of new arts and new processes. He properly cites the comparatively modern discovery of the motive powers of elastic vapours, the wonders of telegraphy, the destructive explosiveness of various compounds (even when as innocent looking as gun cotton), as instances which serve to show that we have by no means reached the limits within which man may bring his own powers to the aid of physical conquest, and, therefore, he calls upon his readers to understand, that when he speaks of the apparent

impossibility of repairing the injuries which have been inflicted upon immense tracts of country by the improper action of man, he refers only to the agencies now known to and directed by man. And, indeed, even with the aid of these agencies, however inadequate to the complete restoration of wasted hill-sides and desolated plains to their former fertility and healthiness, we find there is a partial reverse to the ugly picture which I have presented to you.

We have seen in the case of Holland (for example) immense tracks of country recovered from the sea and great lakes drained of their waters, and the land thus laid bare converted into valuable pastures; we see rivers compelled to aid, by the deposit of the slime and silt with which they are charged, in filling up low-lying tracts and swampy morasses; we see fertile oases created even amidst the barren sands of Sahara, by means of Artesian fountains; but all these achievements are on too small a scale to give hope that we shall ever make full atonement for former spendthrift waste, and it becomes our positive duty, imposed upon us as a sacred trust, not merely to abstain from wanton destruction of the natural resources of this country, and from undue interference with those operations which in the past have tended so much to fit it for the abode of mankind, but also, in all cases in which, through recklessness, or carelessness, or accident, anything has been done tending to injure them, that we should endeavour to effect all the reparation in our power.

It has well been pointed out, that if "the old world which man has overthrown, were rebuilded, could human cunning rescue its wastes and desert places from solitude and nomadic occupation, from barrenness, from nakedness, and from insalubrity, and restore the ancient fertility and healthfulness of the Etruscan sea coast, the Campagna and the Pontine Marshes, of Calabria, of Sicily, of the Pelopennesus and Insular and Continental Greece, of Asia Minor, of the slopes of Lebanon and Hermon, of Palestine, of the Syrian Desert, of Mesopotamia, and the delta of the Euphrates, of the Cyreniaca, of Africa Propẽr, Numidia, and Mauritania, the thronging millions of Europe might still find room on the Eastern Continent, and the main current of emigration be turned towards the rising instead of the setting sun." Whilst, therefore, we are devising great political plans for the extended peopling of these Islands, let us not forget how much it is our duty to preserve them from those destructive processes which even civilized man, in ignorance or wantonness, unhesitatingly applies in his attempts to bring new countries under the dominion of his wants.

[The lecturer then proceeded to point out that where natural arrangements are disturbed by man, they are not usually restored until long after he has retired from the field, and free reign has been allowed to the spontaneous recuperative energies of the natural forces. He then continued as follows]:—

And now let me turn to the consideration of some of the more important changes which have already been effected in the physical character and organic life of these Islands. In my former lectures I pointed out how little, if anything,

was to be found amongst the indigenous animal or vegetable productions which was useful for the permanent sustenance of civilized man, and it is only necessary to recall the dreadful extremities to which the first European settlers were reduced in the early days of American discovery, and that, too, in a country whose useful natural productions were enormously in excess of those of these Islands, to understand how little could have been done here, by even the most civilized and energetic settlers, without the aid of the animals and plants which have been introduced.

Take the case of the Province of Canterbury for example. Consisting of several thousand square miles of valuable plain and undulating land and mountain, its lower grounds, near the sea, containing many rich tracts covered with swamp-loving growth, whilst its upper grounds were dry, and clothed either with forest or with waving tussock grasses well fitted to support pastoral animals, it was yet, in its natural condition, utterly unfit for the abode of civilized man. Not a plant did it produce which could have been turned to account for purposes of constant food; and with the exception of a few birds, which would have yielded an occasional but scanty meal, it was devoid of all animal life. But now, how changed is all this! The city of Christchurch, destined, in my opinion, to occupy a foremost position amongst the cities of the colony, built upon a spot of which a large portion was originally a swamp, now presents to us substantial and elegant public and private buildings, which might fairly vie with those of many large provincial towns in England; markets supplied with meats and vegetables and fruits, in no degree inferior, and in many respects superior, to those which are produced in the best gardens of Europe; well kept streets, in which a busy population is carrying on trade and commerce and intercourse; foundries and factories producing machinery and implements of trade necessary for the agriculturist and the artizan; collegiate and other schools for the instruction of youth, and institutions of various kinds for the diffusion of knowledge amongst those of more advanced years, and which in their operations are guided and governed by men whose intelligence and perseverance are not only making their fellow-citizens better acquainted with the natural resources of their adopted country, but are also greatly instrumental in relieving life from the weariness and tedium inseparable from the struggle for fortune—whilst those lighter distractions are not wanting which are essential, at all events to youth. Outside of the city we see extensive tracts of country redeemed from the character of a wilderness; handsome villas with well kept grounds, in which are flourishing the flowers and plants, the trees and shrubs, of many foreign countries; smooth Macadamized roads, along which a great and increasing traffic is carried between the chief city and many outlying towns and hamlets, and upon which are to be seen every kind of vehicle, from the elegant carriage built in England or America to the humble spring cart of the market gardener, and from the huge five-horse coach of the

enterprising Yankee proprietor to the inconvenient cruelty-van drawn by a single jaded horse. On every side, as we travel along these highways, we see evidences of energy and civilization; farms and corn fields stretching for miles on either hand, enclosed by well-kept hedges and fences; sleek-looking cattle and sheep, and happy horses snorting, as with tail and mane erect they canter over their pasture; steam threshing engines puffing their circles of smoke into the clear air, whilst the rumble of the machine as the sheaves pass through the rollers, mingles pleasantly with the various other sounds of country life, all tending to carry the traveller back to those home scenes which are usually associated with his happiest hours. Here, too, we see the mighty iron horse drawing his load along a line of railway, constructed under circumstances and in a manner which, but a few years ago, would have been looked upon with wonder, even amongst the greatest countries of Europe. Indeed, it is almost impossible for those who had not seen the country I refer to in its original condition, to realize the amount of change and improvement which have been effected by the energy and industry of our race in the short space of twenty years, and it is difficult, even for those who have witnessed this gradual change, to comprehend or grasp its wonderful results.

Take again the Province of Auckland. Here we find a chief city, also distinguished by the possession of handsome and substantial public and private buildings; its merchants, men of enterprise, carrying on extensive commercial operations with various parts of the world; its harbour not only filled with ships and vessels the property of Europeans and foreigners, but also teeming with small craft belonging to native proprietors, engaged in exchanging articles of food and export for others either of local or foreign manufacture. Outside of the city, too, we see numbers of handsome country residences, and farms in a high state of keeping and cultivation, and occupying ground which was not long ago the battle field of some of the fiercest native tribes, and the scenes of barbarities at which humanity recoils.

The Province of Otago presents equal evidences of change. Here, too, we have a large and picturesque capital city, vying successfully, if not in many respects surpassing, the other cities of the colony in the elegance and substantial nature of its public and private buildings; its people distinguished not merely by their commercial enterprise and sagacity, but also by the higher characteristic of devotion to the cause of educational progress. Here, also, outside of the chief town, we find civilization spreading its arms over millions of acres, and gradually converting a wilderness into a smiling country, whilst thousands of busy and hardy men are daily engaged in exploring the recesses of its hills and valleys, and the ancient deposits of its river systems, in search of mineral wealth. Indeed, in the cases of Auckland and Otago, not less than in that of Canterbury, it is almost impossible to realize the extent of change which has taken place since they first became the scenes of systematic colonization.

But let us take another and even more extraordinary instance. I mean that of Westland, and the country to the north of it, forming part of the Province of Nelson, and lying to the westward of the Mount Arthur Range and the Spencer Mountains. The whole of this extensive tract consists of broken mountain ranges, attaining, on a base of thirty to thirty-five miles from the West Coast, a general elevation approaching 7000 feet, whilst in Mount Cook we find it rising to upwards of 13,000 feet, and in the Spencer Mountains to upwards of 9000 feet. From these ranges a large number of rivers flow to the coast, the principal ones being the Buller, with its great tributaries, the Maruia, the Inangahau, and the Matakitaki; the Grey, with its tributary the Ahaura; the Teremakau, the Hokitika, the Waihau, flowing from the Mount Cook glaciers; the Haast, and the Arawhata; whilst a host of smaller ones help to carry off the abundant rain-fall by which this district, in common with the western slopes of these Islands generally, is characterized. The country in question is, moreover, densely clothed with forest, consisting chiefly of *Fagus*, after reaching an elevation of seven to eight hundred feet, whilst the alluvial deposits near the mouths of the rivers support various species of the *Coniferæ* of New Zealand, with the usual dense undergrowth.

At a few places along this coast, in and previously to the year 1864, small settlements of natives existed, the people of which lived in great seclusion and poverty, subsisting chiefly on fish and small degenerate potatoes, whilst the whole district remained in the condition of an almost virgin country, showing but little sign of interference on the part of man. In the year 1847, shortly after the establishment of the Nelson settlement, Mr. Thomas Brunner, lately Chief Surveyor for the Province of Nelson, undertook to explore the West Coast of the settlement, and, accompanied by a small party of natives, he succeeded, after undergoing great fatigue and hardship, in reaching a point somewhere to the south of the Grey. He was actually absent for upwards of twenty months, during which time he had no opportunity of communicating with any other European; and, in the journal which he published, he described the country as being rugged, worthless, and unprofitable to a degree, and the rain-fall as utterly excessive. His description of its character, the length of time spent in his explorations, the extreme difficulties and hardships he encountered, were quite sufficient to deter any attempt to utilize it for purposes of settlement, and it remained an almost unknown land until visited, many years after, by Mr. James Mackay, in connection with its purchase from the natives. In 1861, in consequence of suggestions made by persons in Nelson, who were desirous of having further information in regard to its topography, geology, and natural productions, Dr. Haast was appointed by the Nelson Government to make a further exploration, and to report upon it. The result of his examination was embodied in a report presented to the Nelson Government, at the end of that year, in which, however, Dr. Haast made no

suggestion of the rich auriferous deposits which have been since found upon the Grey, and to the north and south of that river. On the contrary, he says in his report that, "north of the Buller, in the Maruia, as well as in the whole course of the Grey and its tributaries, rarely leaving untried any spot which seemed likely, we searched in vain, unable to detect the least sign of the precious metal."

In 1864, reports which had for some time been current as to the existence of gold in payable quantities in the country to the south of the Grey River, were proved to be correct, and shortly afterwards the district in question was "rushed" by an immense body of miners from all parts of New Zealand and Australia. In the course of a very short time towns sprung up, and a great trade was carried on at various points of the coast, but chiefly at Hokitika, Greymouth, Westport, Charleston, and other places, which, but a few years ago, had only been trodden by occasional bands of savages, engaged in a search for greenstone, or upon a mission of slaughter and cannibalism. The miserable remnants of pas, with their wretched half-starved native inhabitants, speedily gave way to the busy haunts of the digging population. The rivers, rarely visited even by the canoe of the savage, are now used as ports by large steam and sailing vessels. The forest in the vicinity of the towns is disappearing, to be replaced by grass paddocks. Good roads and railways are being substituted for the miserable bush track; millions of pounds' worth of the precious metals are extracted from the river courses and their ancient deposits, and exchanged for food and all the other various articles required for the use and the luxury of man, and the hardy diggers, who have set all this in motion, are gradually altering the whole face of the country under the influence of "the sacred thirst for gold."

It is, indeed, wonderful that there is scarcely a nook or cranny in the Middle Island—a country as large as England, though inhabited by a population not exceeding that of a second-rate provincial town—in which, after thirty years occupation, some evidence of the existence of civilized man is not to be found; a fragment of a glass bottle—an empty match-box—a piece of woven cloth—or of manufactured leather—being often discovered in localities affording no other indication whatsoever that man had ever been there; whilst familiar European plants, weeds or flowers, as the case may be, occurring in the most sequestered valleys or upon the most rugged mountain slopes, show the presence of the invader and the effect of the new forces which have been brought into operation, and which are engaged in altering and modifying the original physical features of this country.

[After some further account of similar changes in other parts of the Islands, the lecturer proceeded as follows]:—

There are few subjects of greater interest to the biologist than the "replacement of species" (as it has been termed), which occurs when foreign organisms

are brought into contact with previously undisturbed and purely native races. Now, there can be no doubt that whenever man transplants a vegetable organism, for example, from its native *habitat* to a foreign soil, he introduces a new force to act upon the indigenous flora, a force which experience has shown to be usually so exerted as to lead to the more or less rapid, but in the long run, certain displacement of some portion of that flora. Dr. Hooker, in his admirable paper on "Insular Flora," has shown how effectually this displacement has been carried out in small oceanic islands, instancing Madeira, St. Helena, and others, but he did not in that essay apply the theory to such extensive tracts of land as the islands of New Zealand.

[The lecturer then adverted to instances of "displacement," collected from the writings of Hooker, Marsh, and other authors, and proceeded as follows] :—

The most important point, however, to be noticed in this connection, and one which must be carefully borne in mind in all investigations into the character and extent of the changes to which I am now referring, is, that man has been either intentionally or unintentionally the chief instrument in bringing them about, and that it is only when he co operates, if I may use the term, with the forces he sets in motion, that they produce any striking or rapid results.

It must furthur be borne in mind, that such operations, when civilized man engages in the work of colonization, are usually conducted on a very large scale, and this whether the result be intentional and contemplated, or unintentional and unforeseen. And it must still further be observed, that man is naturally aided in this respect by the circumstance that vegetable organisms when naturalized in a new country, either as the result of design or accident, generally exhibit an increased luxuriance of growth. This is attributable, amongst other things, in the first place to the fact that they have been removed from the influence of those checks to undue increase which have gradually developed themselves in their natural habitat, whether under the operation of the laws governing the "struggle for life," or in consequence of their interfering with the cultivation of the soil; in the next place to the existence of that attribute to which Mr. Darwin has applied the term "prepotency;" and, moreover, to the circumstance that the indigenous vegetation is invaded by a new and unexpected force, against which it had not previously been armed. Until the Ngapuhi tribes had become possessed of firearms, the wars of the New Zealanders were conducted upon a general scale of equality; but the possession of this force gave to that tribe an increase of power which led to the most frightful results to other tribes. Bands of these heroes marched from one end of this Island to the other, spreading desolation and terror, and ultimately driving the whole native people to the alternative of either adopting a different system of living and of warfare, or of submitting to extinction. The

European cardoon which broke out of some garden on the banks of the River Plate, acquired a gigantic structure, and rapidly spread, in impenetrable thickets, over thousands of square miles of the Pampas. The *Anicharis alsinastrum*, a water plant not much inclined to spread in its native American habitat, has found its way into English rivers, and in some instances has not only greatly retarded their currents, but has formed a serious impediment to navigation. The water-cress introduced into the River Avon, in Christchurch, has spread to such an extent as to obstruct the flow of the river and greatly to raise its natural level, evils only counteracted by the annual expenditure of large sums of money. The Scotch thistle is spreading over both islands, and has already entailed upon the farmer and the squatter a serious addition to his expenses.

So far as New Zealand is concerned, there can be no doubt that what is taking place must be at the expense of the native flora, and must, even alone, have sooner or later led to the extirpation of many of the native plants. But when, in aid of these operations, we find the whole country roamed over by man himself, and by countless herds of animals which he has introduced, we may feel assured that the native life has but little chance against the invaders. Wherever we fire the forest or cut a track, we make room for the invader, and where the hardy European vegetable once begins to grow it usually retains its hold. I noticed recently, at sub-alpine elevations in the Middle Island, that *Trifolium pratense* was gradually displacing native herbaceous vegetation, a process the more certain in proportion to the treading which the soil receives from cattle and sheep. But, perhaps, one of the most noticeable facts is, that along our lines of highway, especially in the Canterbury Province, you scarcely see, for miles together, a single native plant in the hedge rows or fences, whilst the familiar wayside weeds of Europe are found as abundantly as they are in the mother country.

The author concluded his lecture by observing (in the words of an eloquent author), "that the mysterious but undeniable movements which he had attempted to elucidate were ever going on, progressing on a grand and imposing scale, and altering the vegetable character of the whole country, showing, in indelible signs, the silent but irresistible force with which humble plants may prescribe a path to man, and that strange relation between them which makes plants of equal importance to his existence and to his welfare."

The author then apologized for not having extended his lecture to the case of the fauna as well as that of the flora, but pleaded his pressing engagements as his excuse. He, however, expressed a hope that on some future occasion he should be able to deal with the subject.

NOTE.

Since the above Lecture was delivered I have observed that Professor Rolleston is reported in *Nature* (No. 47, Sept. 22, 1870, p. 426) to have made the following remark in addressing the Biological Section of the British Association, in September last, namely, "To this I would add that experiments with a positive result, and that positive result in favour of the second hypothesis, if hypothesis it can be called, are being constantly tried in our colonies for us, and on a large scale. I had taken and written here of the *Polygonum aviculare*, the "knot" or "cowgrass"—having learnt on the authority of Dr. Hooker and Mr. Travers (see *Natural History Review*, January, 1864, p. 124., Oct., 1864, p. 619), that it abounds in New Zealand, along the roadside, just as it does in England—as a glaring instance, and one which would illustrate the real value of the second explanation even to an unscientific man and to an unassisted eye. But on Saturday last I received by post one of those evidences, which make an Englishman proud in thinking that whithersoever ships can float thither shall the English language, English manners, and English Science be carried, in the shape of the second volume of the *Transactions of the New Zealand Institute*, full like the first, from beginning to the last page with thoroughly good matter. In that volume, having looked at its table of contents, I turned to a paper by Mr. T. Kirk on the Naturalized Plants of New Zealand, and in this, at p. 142, I find that Mr T. Kirk prefers to regard the *Polygonum aviculare* of New Zealand as indigenous in New Zealand. Hence that illustration which would have been a good one falls from my hands."

I regret to differ with Mr. Kirk in regard to *Polygonum aviculare* being indigenous in New Zealand. In common with others, who for upwards of twenty years have had large opportunities of observing the flora of this country over very extensive areas, I look upon it as an introduced plant. Dr. Hector and Mr. Buchanan in particular both concur with me on this point. The natives, moreover, who suffer much inconvenience from its spread, call it a "pakeha" or foreigner.—W. T. L. TRAVERS.

Art. LXVIII.—*On the Political Economy of Railways.*

By H. S. Chapman, One of the Judges of the Supreme Court of New Zealand.

[*Lecture delivered before the Otago Institute, August* 24, 1870.]

The subject upon which I propose to address you has been brought prominently under public notice of late, by what is commonly known as the financial policy of the Government. Of that policy generally it would be unbecoming in me to speak, nor is it, indeed, a fitting subject for discussion in this place. One part of that policy, however, consists of a proposal to establish an extensive system of railways throughout the colony by means of a loan raised in England; and as that proposal involves certain principles of economical science, I connect those principles with my subject by the title which I have given to this paper, and I think you will find that the observations, and the calculations, which I am about to present to you, will fully bear out the title which I have chosen. I may here observe that it is only a limited portion of the results and consequences of railway enterprise which I propose to discuss, namely, the effect upon the public wealth. In thus confining myself within narrow boundaries, I am sensible that I leave out much more than I embrace. Railways are the offspring of an advanced civilization. They also react upon and tend to develop the very civilization of which they are the fruit. Thus they assume the characteristics of both cause and consequence. They are fraught with important social and political results. United with the electric telegraph, the steamship, and a free press—the operations of which they tend to facilitate—they aid in promoting peace among nations, and the interchange of the best thoughts current throughout the world. These social and political advantages, however tempting they may be, I must leave entirely untouched for the present, and I shall only permit glimpses of them to appear when I think it necessary to remind you of the limits which I have chosen. You will understand, therefore, that I intend to confine myself to an investigation of the modes in which railways tend to augment and distribute the wealth of the country. As I had some share in carrying into operation an extensive railway system in a neighbouring colony, I have necessarily turned my thoughts a great deal to that which I have ventured to call "the political economy of railways;" and it is to the Colony of Victoria that I shall turn for the facts and illustrations to which I am about to direct your attention.

The Colony of Victoria has now in operation about 252 miles of Government railways, namely, from Melbourne to Geelong and Ballaarat, about 100 miles, and from Melbourne to Castlemaine, Sandhurst, and Echuca, on the River Murray, about 152 miles. There are also short railways radiating from Melbourne to the port and suburban districts, making about 20 miles more. Thus Victoria has now completed about 272 miles of railway. I do not

propose to say anything more on the short railways constructed by private companies, or to draw any illustrations or inferences from them. To make my remarks as intelligible as possible, I shall confine myself as near as possible to round numbers, calling the length of the lines 250 miles, and the capital expended in their construction £8,000,000. Thus, the prime cost of the Victorian railways, including stations and the first outlay for rolling stock, was no less than £32,000 per mile. Perhaps a very minute analysis of the different classes of expenditure would bring out a slightly different result, but dealing, as I do, with round numbers, this is accurate enough for my purpose. Now, when it is considered that the Government had no parliamentary charges to pay, beyond the ordinary expenses of printing a public bill, that the necessary legal expenses were included in the general legal expenses of the law officers' department, and that there was very little to pay as compensation for land taken, the cost per mile must be considered large; but it had been deliberately decided by the Legislature that the railways should be constructed in the most substantial and durable manner; and so far as Victoria is concerned —a wealthy country without debt—I believe that decision to have been a wise one. Moreover, it should not be forgotten, that owing to recent improved methods, the work could now be done much more economically than was possible twelve years ago. In this colony, where we have to cover a great extent of country with only moderate means, so costly a system would be altogether inapplicable, and it is anticipated that our railways will not cost more than one-fifth or one-sixth of the above sum. This may, perhaps, turn out to be a somewhat sanguine estimate, but if we fail in the end to obtain 1500 miles of cheap railways for seven millions and a half of money, the ultimate total will not fall many hundred miles below it.

Now, our New Zealand railways are at present so completely in the womb of the future, that I must necessarily resort to what has been done in Victoria for the principles upon which I am about to expatiate. I am not disposed to deal in the speculative, but I think you will perceive that the inferences which I am about to draw, apply to our case as well as to the case of Victoria. The difference between the two will be a difference of degree only.

I will begin with the loan. Here I must remind you that the condition of a colony presents economical features the reverse of those presented by what is called an old country. In England, everything is abundant and cheap except land; land alone, in relation to capital and labour, is limited, and therefore dear. In the colonies, on the contrary, everything is scarce and dear except land. Unoccupied land is abundant and cheap. Capital and labour are among the plentiful and cheap things in England; they are among the scarce and dear things in the colonies—meaning always in relation to land. What Mr. Wakefield called "systematic colonization," as distinguished from mere emigration, consists in transporting what is

abundant and cheap in England, and especially capital and labour (not the one without the other) to the new and more extended field. Taking advantage of the abundance of mere money capital in England, Victoria borrowed £7,000,000 out of the £8,000,000 destined for railway purposes, in the London money market. Practically, what Victoria proposed to the English capitalists was this: "You can barely obtain 4 per cent. for your money, and that often on questionable security; 'the elegant simplicity of the three per cents.' only affords you about 3¼ per cent.; but money is worth to us about 8 per cent. Let us then divide the advantage; we offer you 6 per cent. for your money, by which we shall save 2 per cent., and you will gain 2 per cent." So well did the English capitalists think of this proposal, that they gave for the £7,000,000 a profit, in the shape of premium, amounting to £385,000. Now, in exporting our securities to England, where mere money capital is constantly accumulating and outgrowing the means of profitable investment, what reason is there to suppose (provided the money market be judiciously fed), that the results will be otherwise in principle, if not in degree, to that exhibited by the Victorian loan? I believe that the public in England have a very vivid, and I may add a just, impression of the great natural resources of New Zealand. The integrity of our public men is beyond question. Why, then, should we not anticipate that, as we the borrowers want lenders, and as they the lenders are equally on the alert to find good borrowers, we shall secure some profit on our securities, if a favourable condition of the money market be chosen, though it would be undoubtedly rash to attempt to anticipate the figure or per-centage?

I now desire your attention to that which I consider the most important economical result of all means of cheap transport, and especially of railways, as exhibited conspicuously by those of Victoria. All that I am about to point out to you is equally true of common roads; but when we spend a sum of money on a Macadamized road, it becomes quite impossible to keep the sort of account which I am about to present to you.* To enable you to appreciate the change which has been brought about, I must carry you back to what, considering the rapid march of the colonies, I will take leave to call ancient times. When gold was first discovered in Victoria—not quite twenty years ago—the country was without roads, and was too poor to make them. The population was 71,000, spread over a country without inland towns and without much internal trade. As miners, or rather diggers (for mining, proper, did not at first exist), seated themselves where gold was most abundant, the towns of Ballaarat, Castlemaine, Sandhurst, Maryborough, and some few others

* In the ten years ending 1861, Victoria expended upwards of £5,000,000 on roads and bridges. Cartage was reduced from the fabulous rates mentioned in the text, to some £6 or £8 per ton. The capital expended was equal to a perpetual annuity of £3000 a-year; the gain was perhaps four or five times that amount.

grew up, and traffic, with horse and bullock drays increased naturally to meet the wants of the population. In winter the old bush tracks became so cut up as to be almost impassable, and as much as £60, £80, and even £100 per ton has been paid for the carriage of goods to Sandhurst. These high prices, however, were partly due to the abundance of money. From 1852 to 1858, very large sums were expended in the construction of roads, and just before the opening of the Northern Railway as far as Sandhurst, the cost of carriage was reduced to £6 10s. per ton in winter, and to £5 10s. in summer, the mean rate being about £6 per ton. To Ballaarat the mean rate for the year was about £4 10s. per ton. As I am merely engaged in working out a principle, it is unnecessary to seek for perfect accuracy; let us, therefore, assume that at the time of opening the railway to Sandhurst, the average rate of cartage for the whole distance was £5 per ton; and at this reduced rate the carriers had the advantage of 21 miles of railway. During the first year, after the lines were opened to Sandhurst and Ballaarat, rather more than 200,000 tons of goods were carried. I have not any very recent statistics, but from the rate of increase and the opening of the line to Echuca, I believe that 300,000 tons of goods and produce, *at least*, pass over the two lines—by far the greater part being carried to and from the great seats of population, and only a small portion being dropped by the way; but for the portion so dropped I will deduct one-third, and base my calculation upon the assumption that 200,000 tons of goods and produce are carried to and from Melbourne to the great seats of population. The gain, therefore, to the consuming public is on 200,000 tons of goods carried the whole way. What is that gain? At first the charges were 50s. per ton to Sandhurst, and 42s. per ton to Ballaarat; but it has since been reduced to about 35s. and 40s. per ton. I will take the average at 40s., and thus we have a net saving of £3 per ton, or about £600,000 a-year. This is the saving spread over the whole body of consumers by means of cheaper transport. Whether this estimate be precisely correct or not (I believe it to be within the mark), it is absolutely certain that whatever is saved by the improved means of transport, is so much added to the material wealth of the country. It may not be all preserved as wealth. Part may be at once expended in immediate enjoyment, but part will remain as wealth. The subdivision in some cases is so infinitesimal, that it escapes appreciation. A saving of £3 per ton is about one-third of a penny per ℔. This is not much on every teaspoonful of sugar which is put into the old dame's tea, but it is something substantial on the 4℔. loaf, especially when multiplied by all the loaves consumed by a family in the year.

By way of parenthesis, but at the same time not wholly unconnected with my subject, it may be amusing to state what I actually paid in 1854 for some of the articles of ordinary consumption in a family. I have paid 35s. per cwt. for potatoes, at the very time that farmers in some parts of the country were

complaining that their potatoes were rotting in the ground for want of labour to dig them, and of roads to convey them to market. I paid 4s. per lb. for butter, 1s. 8d. per quart for milk, 6s. a dozen for eggs (they had just before been 9s. per dozen), 2s. 6d. for a cauliflower, and 1s. 6d. for a cabbage. The health of the town population then suffered for the want of fresh vegetables. Bread was more than 1s. for the 4lb. loaf, and had been higher. Labour was 20s. a day, and yet the labouring classes really suffered from the insufficiency of their wages to purchase food and other necessaries. Everything seemed out of joint. A turkey cost 50s. In 1862, eight years afterwards, I could buy similar turkeys for 7s. 6d. Oats were 20s. per bushel, and hay £24 per ton. Fine times for farmers! you will exclaim. Not so, however, for the greater part of these high prices was lost and wasted in the cost of conveyance. I shall have to recur to this part of the subject in treating of another branch of railway economy.

Hitherto, I have only taken into account the goods traffic, but the passenger traffic is of nearly equal importance; and if we were now considering comfort, health, and social advantages, I could show that the carriage of passengers is even of more importance than the transport of commodities. In the early days of the gold discovery, the coach fare from Melbourne to Ballaarat was £6, and I believe even more. As road-making proceeded, the fare was reduced to £4, then to £3, and, during some short periods of competition, even to less. It was about one-third higher to Sandhurst, which was a long, dreary, and fatiguing journey. The charge to Ballaarat for a first-class ticket is now, I think, 30s.; and about 35s. or 40s. to Sandhurst, and the second-class fare is about two-thirds of the first. I cannot be quite certain of these rates, as I have not the last *Bradshaw*. Even the second-class accommodation is in every respect more comfortable than that of the best constructed coaches. Travelling has of course greatly increased. Taking the short stages with the long, it is perhaps ten times what it was in the old coaching days. A man can now go to Ballaarat or Castlemaine, transact his business, dine with a friend, or marry a wife, and return without fatigue to Melbourne in the same day. The saving of time, the increase of comfort, the absence of fatigue, are gains which really possess a money value, though they baffle a money estimate. The mother can with ease visit a sick child, the daughter a dying parent. These, and similar advantages, cannot be set down in figures, yet they are gains for which every one is willing to pay in shape of tax. Taking the money gains alone upon the passenger traffic, I am convinced that it is not an over-estimate to set it down at between £300,000 and £400,000 a-year, spread over a very large proportion of the whole population of Victoria, who are becoming, under the new railway facilities, as much a travelling people as the Americans. Thus, then, with a population of about three-quarters of a million, we have a total gain of nearly one million. Indeed, in the present year, it probably exceeds that amount.

But this is a gross and not a net gain, and it becomes necessary to enquire what the people pay collectively in their character of taxpayers, in order to secure this gain of a million which reaches them individually. This we can ascertain with more exactness than the computation of the gross gains was susceptible of. The railway loan bears interest at the rate of 6 per cent. per annum. I have already pointed out that it yielded a profit of £385,000, which is equivalent to a reduction of interest. I will not, however, embarrass the calculation with too great precision, but will set down the charge against the consolidated revenue, to which all taxpayers contribute, at £500,000. It is unnecessary to take the capital into consideration, for if it were paid off to-morrow it could only be paid off with colonial funds, which would yield an interest or profit if otherwise employed. Suppose the Government were to find a great deposit of gold, worth £8,000,000, and were to pay off the loan therewith, and so extinguish the annual interest, the same interest, or something near it, ought still to be deemed a charge against the railway enterprise of the colony, because that interest would be yielded if the new eight millions were invested otherwise, instead of in paying off the railway loan. Five hundred thousand pounds a-year may, therefore, be set down as the dead weight of the railway enterprise of Victoria.

But as the gross gain is not all profit, so this dead weight is not all loss. It is partly met out of the revenue of the railways for goods and passenger traffic, after deducting therefrom the working expenses of all the lines. I have no later returns than those of 1864-5, which I regret, as later accounts would be much more favourable. The traffic receipts of that year are set down at £546,000, and the charges against this are as follows :—

Salaries and wages	33,350
Departmental contingencies . .	220,372
Total working expenses . .	£253,722

Deducting this sum from the traffic returns, we find the net revenue to be £292,278, and deducting that sum from the interest on the debentures, which I have called the dead weight, the net deficiency is £207,722. But, although this is a real deficiency, it can only be regarded as an apparent loss. It is the sum which the people of Victoria are willing to pay, and do pay, out of the general taxation of the country, in order to secure a gain which I have ventured to estimate at £1,000,000, distributed over the whole population; though, as I shall hereafter show, not with exact equality, and not in all cases in the same shape. I cannot, of course, pretend to speculate as to the results of the future railways of New Zealand, but the same principles apply here as in Victoria. At first our railways may only just pay their working expenses, or, perhaps, a little more. In that case, what I have called the dead weight will be subject to little deduction. But I can scarcely conceive the possibility

of the gross gain from cheap transport failing to exceed very considerably the dead weight. That excess, whatever it may be, is the net profit of the railway system. Comfort, health, ease, the saving of time, the facilitating of business, and the interchange of the family affections, are substantial advantages which do not immediately belong to my subject, but which ought not to be left out of consideration, although we cannot reduce them to figures.

Our roads in this country, except for a few miles outside of the principal towns, are much in the condition of many of the English roads at the end of the last century, when General Wade first improved the Great North Road beyond Leeds.

> "If you'd seen but these roads before they were made,
> You would hold up your hands and bless General Wade."

Englishmen who have only known the transition from the four-horse coach of 1830, so splendidly appointed and so well worked, to the railway of recent date, can form no conception of the change in Victoria, or the change which the railway system will produce here. It is a change from misery, not without danger, to comfort and safety—a sudden leap from the middle of the eighteenth to the middle of the nineteenth century. Mr. Wentworth, in 1851, said, "The discovery of gold has precipitated us into a nation." The idea was excellent, but the mode of expressing it was not happy; but may we not say that a well-considered railway system will go far to elevate us into a nation?

There is another economical result which has disclosed itself very conspicuously to those who have carefully marked the effects of the railway system in other countries. It is comprised in the phrase, "equalization of of prices." It is not in itself an independent gain. It is simply the mode in which the sum-total of gains from cheap transport distributes itself between producers and consumers. Now, if this equalization of prices has made itself manifest in countries (England for instance) where the transition has been only from excellent common roads to railways, how much more conspicuous will it not be where the transition is from bad roads, or no roads, to railways?

Let me explain this phrase, "equalization of prices." It is not so much in the larger productions of agriculture, such as wheat, oats, potatoes, and so forth, that the equalization will appear. These, wherever practicable, are conveyed by water, by the coasting steamers; but to some extent it will operate upon such productions. It will, however, be most conspicuous in the productions of the small farmers and dairymen, who raise poultry, butter, bacon, etc., for the town markets. We will take a single article as an illustration, and it is not of much importance whether we state the prices accurately. We are quite at liberty to assume an arbitrary price as an illustration of the principle. Fowls are now, in Dunedin, 6s. per couple. We will suppose that fowls are produced in some parts of the country not very accessible to the town, or so

situated as to make the town inaccessible to the producer. In such a case the remote country price would be, let us suppose, 2s. per couple. Though these assumed prices are not of much importance, they are such as I have known to coincide. Now, what I have described as taking place in the case of a railway loan, may be anticipated as certain to take place in the case of the productions of the small farmer. The cost of transmitting poultry by railway is very small; deducting that cost, the producer and consumer will share the advantage between them in proportions to be determined by a double competition, that is, the competition of producer against producer tending to lower the price,—the competition of consumer against consumer tending to raise the price. If these two competitions be of precisely equal force, then (leaving out the trifling cost of conveyance as being infinitesimal in this case) the consumer who has hitherto paid 6s. will get his fowls for 4s., and the producer who could only get 2s., if indeed he could sell at all, would now get 4s.* It is unnecessary to dwell on other articles. The town consumer will get his bacon, hams, butter, eggs, and cheese at perhaps one-third less, while that same reduced price will yield to the small farmer perhaps one-third or half as much more than he can now obtain. Let it not be supposed that this is speculative or chimerical. Remember, that I could purchase in the Eastern market of Melbourne as good a turkey for 7s. 6d. in 1862, as cost about seven times as much in 1854. Let me once more remind you that I do not state this as an additional gain, but only as explanatory of the mode in which the whole gain arising from cheap transport distributes itself.

I cannot resist the temptation of illustrating this part of the subject by

---

* As an illustration of this double competition, and of the manner in which the relative forces of the two may be disturbed, I may here refer to the mode in which the Victorian debentures were placed upon the London money market. The loan was negotiated through the six principal banks of Melbourne. They agreed to supply the Government with money, in sums required from time to time, and to hold the debentures as security at a limit—communicated at first under sealed cover. Under that limit they were not to sell for a certain stipulated time; but when their advances reached a certain amount, and after the expiration of the time agreed upon, they had power to sell in order to replace their advances, and to enable them to supply the renewed wants of the Government. To prevent the six banks from competing with each other, it was however stipulated that the sales were to be effected through one bank only; in other words, that the market should be fed through one conduit pipe only. The effect of this was to reduce the force of the competition of sellers against sellers tending to lower the price, while it left unaffected the competition of the buyers. Thus the balance of these two forces being on the side of the buyers, the result was the profit of £385,000 which I have mentioned. If the six banks had been left free to compete with each other, and had not substituted for the condition in the contract which I have mentioned some equivalent arrangement among themselves, that competition would have acted in some degree against the force of the competition among the buyers, and the result would probably have been a lower premium and a smaller aggregate profit.

another case. In the Wairarapa Valley, forty miles from Wellington, are some magnificent totara forests. There are also saw-mills which cut the totara logs into boards. But the difficulty is in conveying the bulky boards from the place of production to the place of consumption, the road being a mountain road over the Rimutaka ranges, 2500 feet high. The cost of conveyance is consequently heavy, and while the price at the mill is under 10s. per 100 feet, the price in Wellington is something like 18s. per 100 feet. Now, surveyors well acquainted with the country affirm that there is a practical, and by no means difficult line for a railway; and should one be constructed, the boards could be conveyed to the town for (let us suppose) 2s. per 100 feet. Here then would be a saving in the cost of delivering the boards in Wellington of 6s. per 100 feet, or about 33 per cent. The difference between 18s. and 12s. (the real gain) would be shared between the producer and consumer on the principle which I have already explained. . In time, the consumers in the town would probably secure the greater part of the saving, but the producer would reap his advantage from the greatly increased demand.

Let me now mention a case not of simple interchange (though it partly bears that character) but of substantial saving, in addition to the mere saving in the cost of transport. Very soon after the opening of the line from Melbourne to Sandhurst, slaughter yards were opened at the latter place for the supply of Melbourne with meat. It is well known that oxen and sheep, when driven to a distant market, fall off in weight and condition. They lose fat, and every one knows that the loss of fat involves the loss of flavour and of nutritious qualities. These disadvantages were obviated by slaughtering the animals at Sandhurst and sending the carcases to Melbourne. There was gain in many ways. Weight and quality preserved, expense of drovers got rid of, carcases capable of being packed in a smaller space than live stock—though live stock also was transmitted to a considerable extent. Here, as elsewhere, we are inevitably approaching the boiling down phase of pastoral enterprise. Along the lines of railway, the legs of the sheep, which yield but little tallow, but which afford the best food, will be sent to the town consumer, while the tallow-yielding parts of the animal will be boiled down as near to the station as possible. By the process of equalization, the result of competition, the consumer will get cheaper legs of mutton, while the boiler-down will get a sale for what to him is the useless, or, at all events, the least useful part of the animal. With the cheaper carriage for the latter, the boiler-down will be able to offer to the squatter better prices, and even the distant consumer of tallow will "share i' the gains." Cheap carriage may not always show itself in better prices, but rather in arrested decline. Though no one can possibly analyse the distribution in figures, which, in the case of a single transaction may be infinitesimal, that distribution does most certainly adjust itself by natural laws—as certainly indeed as the laws which regulate rain and sun-

shine, although we cannot trace the distribution to its ultimate resting place.*

I now come to the effect of railways upon the town and country populations respectively, and I may add reciprocally. Within my lifetime, which in spite of my grey hairs is a very short time in relation to the progress of a nation like England, London has increased from under one million to something over three millions of people. A very large part of this increase has taken place since the institution of railways, and it is usually, and I believe justly, attributed to the stimulus given to production and trade by the rapid development of the railway system. But it is also in part attributable to the effect upon production and trade of the gold discoveries in California and Australia. In America, and on the Continent of Europe, similar development from similar causes is observable. But not to travel so far from home, let me call your attention to what has taken place in Melbourne, because I shall apply that case to New Zealand, with, however, a difference to be presently pointed out. The Northern Railway of Victoria reaches the Murray River at a place called Echuca. The Murray River is navigable for steamers, except during a few months in summer, for a distance of 1754 miles. Its tributaries, the Edward, the Wakoul, and the Billobong, are navigable during a part of the year for about 300 miles. The Murrumbidgee, with its several expansions or lakes, has been navigated to Gundagai, about 900 miles. The Darling has been navigated for some 800 miles, and the Lachlan has been ascended, but I am not aware how far. All these streams fall into the Murray, and they are all shallow in the dry season, but at other seasons we have here specified an inland navigation of some 4000 or 4500 miles. The Murray might be made navigable during the whole year, but at present, in the dry season, when the water is low, the channel is choked by snags. In 1862, there were twelve or thirteen steamers on the Murray, measuring about 2500 tons, and moved by about 450 horse-power, and these had an attendant flotilla of barges. As the line from Sandhurst to Echuca has been opened since 1862, I have no doubt that the tonnage has increased, but of this I have no account. The Murray is the boundary between New South Wales and Victoria, and the country north of the Murray, which is watered by the rivers already named, is usually

* I may here mention, very briefly, that under the railway system proposed to be established in New Zealand, the advantages of both saving and equalization of prices are likely to be greater in proportion to the capital employed, and the proportion of population directly reached, than in Victoria. When Victoria opened her 250 miles of railway, the population was but little over half a million. By the system of inexpensive lines, we should have at least four and perhaps five times the extent of railway for the same money, with about half the population at first, and perhaps about the same number when the lines are completed. Thus our railways will penetrate to a greater distance, and embrace and influence a much larger extent of country; in other words, the advantage will be brought within the reach of a larger proportion of the people. It is quite impossible to calculate this; but it must be very obvious.

called Riverina, and is within the colony of New South Wales. Now, the Northern Railway, at its Echuca terminus, taps, as it were, the whole of this inland navigation, and brings the whole Riverina trade to Melbourne. New South Wales governs Riverina, but Sydney is not its commercial metropolis. Most of the Riverina squatters and traders transact their business at Melbourne, and when the Judges of the Supreme Court of New South Wales go circuit to Deniliquin, they find it convenient to go by sea to Melbourne, and thence by railway to Echuca—a coach conveying them thence to the circuit town. Melbourne is thus not only the capital of Victoria, but is the metropolis of a vast interior, into which settlement is rapidly extending. At Cooper's Creek, the starting place of Burke and Wills, and not far from which they died exhausted, there is now an accommodation house for travellers. One striking piece of evidence of the metropolitan character of the City of Melbourne is furnished by the press. What the *Times* is to Great Britain, the *Argus* is to Australia. It is not merely the Melbourne paper, it is the Australian paper. Primarily, it represents the opinion of its Victorian subscribers; secondarily, it is the embodiment of public opinion in Australia.

From the geographical features of New Zealand, and the manner in which settlement has been made, we cannot have a great metropolis. There are many disadvantages in this—economical, social, political; but it is quite inevitable; our town populations cannot be so concentrated, but must ever be distributed between Dunedin, Lyttelton (with Christchurch), Wellington, Auckland, and the smaller coast towns. Notwithstanding this, there are good grounds for anticipating that what has taken place in Victoria upon a scale exceptionally grand, will take place in New Zealand in a minor degree, and, so to speak, distributively. Who can doubt that if the Hutt River, which falls into Port Nicholson, had been navigable for only 100 miles into the interior, Wellington would now have been a considerable city. Who can doubt that if the harbour of Dunedin had enjoyed the advantage of a navigable river, the growth of the city would have been much more rapid than it has been. The same may be said of Auckland, with its fine harbour. That which navigable streams would have done here, had they existed, will be effected by railways—though, of course, in a minor degree and less rapidly and effectually

The growth of towns depends upon the prosperity of the country. The country population mainly consists of producers, that of the towns of distributers and exchangers. This division, though convenient and intelligible, is neither perfectly accurate nor perfectly exhaustive. It is not quite accurate, because distributers and exchangers (that is, merchants, agents, brokers, and carriers) are really producers. They perform a service, and add a value to the produce and goods which pass through their hands. The division is not exhaustive, because there are direct producers in all towns, and there are distributers—that is, traders—in all parts of the country. Still, it is con-

venient to distinguish the town from the country populations by the salient feature which each exhibits. Now, it is almost a self-evident truism to say that, in proportion as settlement spreads throughout the country and the land becomes occupied by direct producers, there will be a continually increasing demand for more traders of various classes, by whom the increased exchanging and distribution must be carried on. If facilities of intercommunication, which is only another expression for cheapness of transport, have the effect (of which I, for one, have no doubt) of promoting the settlement of the country districts and stimulating production, the town populations must increase in a corresponding ratio. More producers will require more exchangers. Between the producer and the consumer there is almost always one middle man, and generally more than one. The wholesale dealer and the retail dealer, the sea carrier and the land carrier, often even an agent or broker between these, are all set in motion by increased production; and they are all, or nearly all, dwellers in towns.

I now approach the last branch of my subject, and it is one which presents some complication, and therefore somewhat greater difficulty. The gains which I have enumerated will not, and cannot, be shared equally by all classes of the community, whilst the price which we must pay in order to secure these gains will (until railways pay a profit equal to the interest on the capital expended upon them) be borne by the whole population. No taxpayer can escape his contribution to the charge, howsoever small his share may be, while his remoteness from the lines of railway may deprive him of direct benefit. This is undoubtedly inseparable from all internal improvements, but if the people of every district could successfully oppose improvements in every other district, improvement could never begin. In the case of railways, however, the advantages are more generally diffused than those arising from ordinary local improvements. In the first place, a trunk railway is partially available to persons living at considerable distances from its line of progress. They will generally be able to send their produce to the nearest station, which will secure to them the benefit of a portion of the line. Thus the wave of cheap transport, as well as the wave of equalized prices, though continually diminishing in its advance, does in practice reach to considerable distances. Still, it must be obvious that there will always be remote localities, which the beneficial influence cannot directly reach. But there is an indirect consequence which is felt universally, and that alone, I think, is worth the small share of taxation which, as I have said, those who reside in localities remote from the railway lines cannot escape from. This benefit, arising out of cheapness, which indirectly reaches all and invigorates all, I will now endeavour to explain.

If, as I trust I have proved, there is a saving from cheap transport spread over the whole community, what is done with that saving? A portion, no doubt, will not ultimately be saved at all. Those who find it hard to

support their families will increase their comforts. If they save in one thing, they will expend more on other things. Confined to the bare necessaries of life before, they will very properly indulge in a few comforts. But there can be no doubt that, when once saving becomes practicable, accumulation is the result. This accumulation it is which adds annually to the wealth of all countries which are still progressive. But even this accumulated wealth requires further analysis, because it is not all accumulated wealth, the benefit of which spreads throughout the country. Mere accumulated wealth is not capital. If the man who saves upon his general expenditure during the year expends the whole or a portion of his savings in purchasing books, pictures, plate, and jewellery, the portion so expended remains still in the condition of wealth. They are "material productions of capital and labour possessing exchangeable value." By the purchase of such things, the purchaser has given employment to the producers of the articles once only. They then remain in his possession in a dormant state. But if, instead of purchasing such articles of wealth as are destined thus to lie dormant in his hands, he devotes a part, or the whole, of his savings to the extension of his business; or if he hand it to others to be productively employed, such portion is continually reproduced, and it continues to set labour in motion so long as it is so employed. The portion of wealth so employed is called capital, or, in other words, the term capital is confined to that portion of wealth which is employed directly or indirectly in productive industry. There is no doubt that spendthrifts are not so unpopular as they ought to be. "They do good to trade," it is said; but in truth, they do good to trade only once, while the more prudent, who save and invest, do good to trade many times; as often, indeed, as their capital is reproduced with the ordinary profits. Of course the wretched miser who saves only to hoard does no good to trade, or to anybody or anything else. But such hoarding is rare in modern times, and the most miserly, now-a-days, employ or invest their savings in some way, so as to reap a profit, and this, as I have shown, is to apply their wealth as capital.

I have said that capital may be employed in stimulating production, and giving employment to labour indirectly as well as directly. If the person who saves be not himself engaged in any reproductive pursuit he probably invests his savings in a bank, or in some other dividend-paying institution. His money, so invested, finds its way into the hands of the active producer; thus he stimulates production indirectly. It is by no means difficult to understand in what manner money nominally lying in banks always operates beneficially in stimulating productive enterprise, and in giving employment to labour. A man who has a good balance at his banker's, for which he cannot find direct employment, is apt to say, "I have so much money *lying idle* at my banker's," but in truth it does not lie idle. If the banker kept the whole idle—if he did not lend it to those who can profitably employ it, "dividend" would be a word

unknown to the English language. The sum total of the balances in the banks, although legally demandable at once, can as safely be relied on by the bankers as a constant average capable of being safely employed in their business. Of course, a prudent and well managed bank must keep a considerable amount of specie to meet all demands; but there is a net balance of deposits which it can use to accommodate its customers. I am not aware what the deposits in the banks in New Zealand amount to, but they count by millions.* In Victoria, in 1862, the deposits exceeded £8,000,000, whilst the reserve of specie was under £2,500,000, so that they must have felt themselves safe to lend five and a half millions out of the deposits of their customers, though the whole of those deposits were legally demandable at once, and without notice, or "at call," as it is technically expressed. It may therefore be no small comfort to any gentleman patriotically disposed, who, for his own convenience, keeps an average balance of £100 at his bankers, to know that he really is an indirect promoter of productive industry to something like two-thirds of that balance; and although he does not deposit his money with any such benevolent intention, he may really be indirectly helping some farmer at Lake Wakatipu, or some miner at Naseby.

It is, in truth, in the order of providence, or, to change the expression, it is a natural law, that we are made doers of good without intending and without knowing it. But how, it may be asked, do our annual savings, whether from cheap transport or any other cause, reach the farmer of Wakatipu? I will answer this question by another: Can anyone tell me of that remote region which is outside and beyond the direct or indirect beneficial influence of banks? The banks lend the money of their shareholders and their depositors to their own town customers, chiefly the merchants and wholesale traders. These are thereby enabled to give increased accommodation and credit to their customers—the country storekeepers. The storekeepers, in their turn, are better enabled to give credit and other accommodation to the farmer; and he, in his turn, gives employment to the labourer. The banks, moreover, by means of their country branches, bring themselves into more immediate contact with the country demand for assistance. Thus it is that every shilling saved and invested goes to swell the aggregate of "that portion of the wealth of the country annually set apart for production."

Thus it is that I believe myself justified in saying that the remotest parts of the country cannot fail to participate in the advantages which spring from railway enterprise. This is really the compensating element of the whole scheme. The direct benefit of railways cannot be equally shared. Those who

* I have since met with the Bank statements in the *Gazette* of the 1st of September. The deposits amount to £3,177,056; the specie reserve is £967,201; the balance available for accommodation, £2,209,855.

use them most, whether for travelling or for transport, get the most benefit. Is not that the case with every improvement? But it is the result of a natural law, that there are other advantages which every man shares in without any effort of his own. So long as a deficiency remains, no man can escape from contribution to it; but then there are some advantages of which no man can be deprived, and if no great improvement is to be undertaken until the benefits can be as evenly and universally spread as the cost necessarily must be, then perish all efforts to improve; for improvement, upon such conditions, becomes impossible.

APPENDIX.

THE CLIMATE OF NEW ZEALAND.

METEOROLOGICAL STATISTICS.

The following Tables, etc., are published in anticipation of the Report of the Inspector of Meteorological Stations, for 1870.

TABLE I. — Temperature of the Air, in shade, recorded at the Chief Towns in the North and South Islands of New Zealand, for the year 1870.

Place.	Mean Annual Temp.	Mean Temp. for (Spring) Sept., Oct., Nov.	Mean Temp. for (Summer) Dec., Jan., Feb.	Mean Temp. for (Autumn) Mar., Apl., May.	Mean Temp. for (Winter) June, July, Aug.	Mean daily range of Temp. for year.	Extreme range of Temp. for year.
North Island.	Degrees.	Degrees.	Degrees.	Degrees.	Degrees.	Degrees.	Degrees.
Mongonui . .	60·7	59·9	65·7	62·3	54·7	15·2	52·0
Auckland . .	59·3	58·1	65·2	60·9	52·9	13·8	46·2
Taranaki . .	57·2	56·7	63·0	58·0	51·3	16·3	48·8
Napier . .	59·3	58·6	67·4	59·8	51·5	16·4	59·0
Wellington . .	55·4	55·0	61·8	55·3	49·4	11·6	46·5
Means, &c., for North Island	58·3	57·6	64·6	59·2	51·9	14·6	59·0
South Island.							
Nelson . . .	55·6	55·4	63·2	55·6	48·2	21·3	55·0
Christchurch .	52·6	50·9	61·2	51·2	43·7	15·8	60·1
Hokitika . .	52·6	52·7	58·7	52·8	46·3	12·7	42·6
Dunedin . .	50·0	51·8	56·1	49·1	43·1	13·1	52·0
Southland . .	49·9	51·5	57·3	48·6	42·4	19·2	59·0
Means, &c., for South Island.	52·1	52·4	59·3	51·4	44·7	16·4	60·1
	58·3	57·6	64·6	59·2	51·9	14·6	59·0
	52·1	52·4	59·3	51·4	44·7	16·4	60·1
Means for Nth. and Sth. Islands.	55·2	55·0	61·9	55·3	48·3	15·5	

TABLE II. — BAROMETRICAL OBSERVATIONS,—RAINFALL, etc., recorded for the year 1870.

Place.	Mean Barometer reading for year.	Range of Barometer for year.	Mean Elastic Force of Vapour for year.	Mean Degree of Moisture for year.	Total Rain Fall.	Mean Amount of Cloud.
NORTH ISLAND.	Inches.	Inches.	Inches.	Sat.-100.	Inches.	0 to 10.
Mongonui	30·010	1·576	·401	75	52·870	5·7
Auckland	30·015	1·398	·418	82	44·831	5·4
Taranaki	29·946	1·536	·355	75	54·720	6·4
Napier	29·881	1·705	·411	80	32·410	2·5
Wellington	29·845	1·270	·361	81	48·205	4·8
Means for Nth. Island	29·939	1·497	·389	78	46·607	4·9
SOUTH ISLAND.						
Nelson	29·870	1·218	·344	77	48·430	5·3
Christchurch	29·882	1·505	·324	81	28·364	5·5
Hokitika	29·934	1·530	·349	87	116·680	5·3
Dunedin	29·867	1·492	·290	79	39·202	5·6
Southland	29·831	1·540	·288	79	53·950	5·2
Means for Sth. Island	29·876	1·457	·319	80	57·325	5·3
	29·939	1·497	·389	78	46·607	4·9
	29·876	1·457	·319	80	57·325	5·3
Means for Nth. & Sth. Islands	29·907	1·477	·354	79	51·966	5·1

TABLE III. — Wind for 1870,—Force and Direction.

Place.	Average Daily Velocity, in miles.	Number of days it blew from each point.								
		N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.	Calm.
NORTH ISLAND.										
Mongonui	172	13	40	41	42	29	75	19	64	42*
Auckland	318	39	43	27	26	57	80	44	26	23*
Taranaki	. .	19	38	9	83	16	106	54	38	2
Napier	242	26	72	15	48	66	65	36	36	1
Wellington	202	31	22	11	104	1	7	1	188	0
SOUTH ISLAND.										
Nelson	148	34	50	9	48	28	93	34	69	0
Christchurch	140	9	43	95	22	23	135	11	21	6
Bealey	133	1	37	1	22	1	25	0	223	55*
Hokitika	185	53	39	59	63	5	55	26	48	17*
Dunedin	171	25	43	19	16	26	50	95	17	74*
Southland	209	47	10	36	64	1	2	132	73	0

* These returns refer to the particular time of observation, and not to the whole twenty-four hours, and only show that no direction was recorded for the wind on that number of days.

Average daily horizontal movement, in the North Island (four stations), 233 miles.
" " " " " South Island (six stations), 164 "
" " " " " New Zealand . . 198·5 "

TABLE IV. — Bealey,—interior of Canterbury, at 2104 ft. above sea.

Mean Annual Temp.	Mean daily range of Temp. for year.	Extreme range of Temp. for year.	Mean Barometer reading for year.	Range of Barometer for year.	Mean Elastic Force of Vapour for year.	Mean Degree of Moisture for year.	Total Rain Fall.	Mean Amount of Cloud.
Degrees.	Degrees.	Degrees.	Inches.	Inches.	Inches.	Sat.-100.	Inches.	0 to 10.
46·8	15·4	65·0	29·770*	1·228	·256	80	106·293	5·2

* Reduced to sea level.

TABLE V. — Earthquakes in New Zealand, in 1870, recorded at the Government Meteorological Stations.

Station.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Total.
Mongonui . .	...	.	..	..	..	..	..	..	.	..	...	...	0
Auckland .	...	.	..	.	..	.	...	..	..	..	..	...	0
Taranaki . .	..	..	.	4	..	.	7* 8	...	29	3, 24	29	..	7
Napier . .	8,15,17	12*	..	.	.	25*	.	.	..	..	2	...	6
Wellington .	...		..	..	3, 25	...	7*	11	30	3	10, 19	18	9
Nelson . .	..	...	.	..	..		7* 8*	22	.	3	19	...	5
Christchurch .	...	...	17*	.	.		..	31*	.	.	...	...	2
Bealey . .	10	..	..		21	13	..	24* 31*	.	..	..	..	5
Hokitika . .	.	.	...	.	14	..	..	31	1	2	...	19	5
Dunedin .	..		..		...	.	.	31	.	...	.	...	1
Southland . .	.	.			..	.	.	.	..	..	...	.	0

The figures denote the days of the month on which one or more shocks were felt. Those with an asterisk affixed were described as *smart* shocks. The remainder were very slight and may have escaped record at some stations, there being no instrumental means employed for their detection. The only shock which damaged property was that at Christchurch on the 31st August.

Notes on the Weather during 1870.

January.—Month marked by excessive rainfall in the extreme north and south of the Islands, and continued dry westerly winds about the central portion, especially on the West Coast; in the North there occurred a storm from N.W. on 28th and 29th, and on same date a severe thunder storm took place in the South from S.W., with heavy rain; at Bealey, 3·750 inches recorded on morning of 29th for previous 24 hours; in Southland, four heavy falls occurred—2·61 (4th), 3·02 (14th), 2·12 (29th), 1·09 (31st), the first three from S.E. and last from N.W. Aurora on 3rd, seen in North.

February.—The weather during the month generally very fine, but rather sultry, with slight rainfall, and on the whole moderate winds. The rainfall, however, in the South was excessive, but no severe gales are reported. At

Bealey, 3·790 inches of rain fell in 24 hours (on 11th), and on 20th, 2·010. Aurora observed on 12th, in South.

March.—Fine steady weather during the month, except on the South and West Coasts, where N.W. storms occurred in the first week. Brilliant Aurora was generally observed on the evenings of the 12th, 18th, and 22nd. Very severe gale at Southland on 5th, 6th, 7th, and 8th, with heavy rain, hail, thunder, and lightning.

April.—Severe weather for the season, especially in the southern parts of the Islands, where the rainfall was in excess of the usual average. Electrical storms were general in the early part of the month, and from 5th to 7th brilliant Auroras were observed. Snow fell at Christchurch on 27th, and hail on 1st, 4th, 26th, and 27th, and snow at Bealey on 1st, 4th, and 25th. At Hokitika, severe gale on 10th, with thunder and lightning; 5·59 inches of rain in 24 hours. Snow also at Dunedin on 25th and 26th, and hail on 1st, 2nd, and 26th.

May.—Stormy weather generally during the month. The rainfall has been above the average. Active eruption of Tongariro, with lava, during this month. Severe storm at Auckland on 8th and 9th from N.E., with slight rain; on the 8th the horizontal movement of wind for 24 hours previously was 1070 miles. At Nelson, 3·45 inches of rain recorded on 9th, during a storm from same quarter. At Bealey, thunder on 3rd, 15th, 16th and 28th, and 2·720 inches of rain registered on 16th; snow fell at that station on 2nd, 3rd, and 23rd. In Southland, on 15th, barometer fell from 29·9 to 28·9, followed by a heavy rainfall from S.E., causing flood.

June.—The weather during the month throughout the colony was generally wet and disagreeable, and in the South Island the rainfall was excessive; the winds were, on the whole, moderate; severe thunder storms occurred. On 15th, at Wellington, there occurred a severe hail, rain, and thunder storm—very large hail stones, loud thunder, and vivid lightning, with bitterly cold S.E. wind. Heavy rain on 25th at Bealey (2·360 inches in 24 hours), and snow on 15th and 23rd. Very heavy rain at Hokitika, especially on 25th, when 3·25 inches fell in 24 hours. Mild weather, but wet, in the extreme South, for the time of year.

July.—The weather was generally wet, stormy, and severe; frequent storms, with thunder, hail, and heavy rain, occurred; on 7th and 8th an earthquake was felt at several of the stations. Tongariro reported active. Strong gale in North from S.W., on 1st, with thunder, hail, and rain; also on 3rd to 10th very stormy from same quarter, with thunder and hail. Stormy weather at Bealey from 2nd to 4th, from S.W., also strong winds, with thunder and heavy rain, at Hokitika, on same dates.

August.—This month remarkable for the stormy weather and excessive rainfall in the northern part of the colony; while in the South and West

Districts the rainfall is much below the average. The atmospheric pressure during the month is lower than the average at every station ; the temperature of air being that usual for this month. On 5th and 6th, severe thunder storm felt at northern stations, with rain and hail. Snow occurred on eight days at Bealey ; snow also at Dunedin on 28th and 29th. Violent thunder storm on 31st at Southland, with heavy snow. Aurora observed on 22nd.

September.—Weather generally fine throughout the colony ; small rainfall, and winds moderate. Brilliant Aurora observed in North and South on 24th and 25th.

October.—Season all over the colony much drier than usual, but in the Northern Provinces amounting to a positive drought. At Bealey, however, on the 4th there was a storm from S.W., with rain, thunder, hail, and snow ; also a gale on 10th from N.W., and on 17th from same quarter, with rain and thunder ; snow also on 12th at this place. At Hokitika, wet southerly weather from 1st to 5th, with thunder. Aurora observed on 24th, 25th, and 26th, North and South. Meteor seen in North on 16th ; very brilliant.

November.—Generally fine during the month, with the exception of a storm, with electrical disturbance, that traversed the whole length of the Islands from N. to S. on 23rd and 24th. Temperature considerably over the average for same month in previous years ; rainfall only slightly in excess in the North, but deficient in the South ; at Nelson there was a long continued drought, with close dull weather, broken only by one day's heavy rainfall on 24th. Aurora observed in North on 19th, and in South on 23rd and 26th. Meteor seen on 20th in South Island.

December.—Very strong northerly winds in early part of month throughout the colony, accompanied at times with severe thunder, lightning, hail, and rain ; latter part of month was generally fine and pleasant at all the stations. Strong gale at Taranaki on 2nd from N., and on 5th from N.W., with thunder and rain ; hail on 4th. On 2nd severe thunder storm at Nelson from N., and on 6th thunder and lightning and strong wind from N.W., and heavy rain—2·30 inches fell in three hours. At Bealey, 4·640 inches recorded on 6th for previous 24 hours, and snow on 4th, 5th, and 6th ; on same dates at Hokitika, heavy gale from E.N.E., with thunder, hail, and rain ; and on 7th heavy squalls with large hailstones, wind N.W. Frequent Auroras observed in South, but most brilliant on 18th.

JAMES HECTOR,
Inspector of Meteorological Stations.

HONORARY MEMBERS

OF THE

NEW ZEALAND INSTITUTE,

ELECTED UNDER STATUTE IV.

1870.

Agassiz, Professor Louis
Drury, Captain Byron, R.N.
Finsch, Dr. Otto
Flower, Professor W. H., F.R.S.
Hochstetter, Dr. Ferdinand von
Hooker, Joseph D., C.B., M.D., F.R.S.
Mueller, Ferdinand von, C.C.M., M.D., F.R.S.
Owen, Professor Richard, F.R.S.
Richards, Rear Admiral G. H., Hydrographer of the Admiralty

ORDINARY MEMBERS.

1870.

WELLINGTON PHILOSOPHICAL SOCIETY.

Allan, J. G., Wellington
Allan, A. S., ditto
Allan, J. A., ditto
Allen, W., ditto
Andrew, Rev. J. C., Wairarapa
Bannatyne, W. M., Wellington
Barron, C. C. N., ditto
Batkin, C. T., ditto
Beale, J. B., ditto
Beetham, W., Hutt
Best, W., Wellington
Bidwell, C. R., Wairarapa
Boor, L., M.R.C.S.E., ditto
Bowden, T., B.A., Wellington
Braithwaite, A., Hutt
Brandon, A. de B., Jun., Wellington
Bridges, J., Hutt
Buchanan, Thomas, Wellington
Buchanan, J., ditto
Buller, W., F.L.S., F.G.S., Wanganui
Chapman, His Honor Mr. Justice, Dunedin
Colenso, W., F.L.S., Napier
Cooper, W., Makara
Cowie, G., Wellington
Crawford, J. C., F.G.S., ditto
Dransfield, J., ditto
Duigan, J., Wanganui
Edwards, Major, Wanganui
Ewald, Rev. H. W., M.A., Wellington
Featherston, I. E., M.D., ditto
Floyd, W. A., ditto
France, Chas., M.R.C.S., Wellington
George, J. R., C.E., ditto
Gillon, E. T., ditto
Gore, R. B., ditto
Gould, George, Christchurch
Grace, The Hon. M. S., M.D., Wellington
Graham, Charles, Rangitikei
Gray, William, Lyttelton
Green, H., Wellington
Hamilton, J. S., ditto
Hart, Robert, ditto
Haultain, The Hon. Col. T. M.
Hector, James, M.D., F.R.S., Wellington
Holdsworth, J. G., ditto
Holmes, R. L., F.M.S., Fiji.
Hurley, J., Wellington
Inwood, D., ditto
Jackson, H., F.R.G.S., Hutt
Johnston, The Hon. J., Wellington
Kebbell, J., ditto
Knight, Charles, F.R.C.S., ditto
Knowles, J., ditto
Knox, F. J., L.R.C.S.E., ditto
Krull, F. A., ditto
Levin, W. H., ditto
Logan, H. F., ditto
Lomax, Mrs., ditto
Lomax, H., ditto
Luxford, W., ditto
Lyon, W., F.G.S., ditto

Magniac, H., Wellington
Mantell, The Hon. W. B. D., F.G.S., Wellington
Marchant, J. W. A., ditto
Marchant, N., ditto
Martin, J., ditto
Mason, Thomas, Hutt
McKenzie, Thomas, Wellington
McTavish, A., ditto
Mills, E. W., ditto
Moore, G., ditto
Nancarrow, J., ditto
Nelson, F., Napier
Ollivier, F. M., Wellington
Pearce, Edward, ditto
Pharazyn, The Hon. C. J., ditto
Pharazyn, C., Wairarapa
Pharazyn, R., F.R.G.S., Wanganui
Pharazyn, W., B.A., LL.B., Wellington
Plimmer, I., ditto
Potts, T. H., Lyttelton
Powles, C. P., Wellington
Prendergast, J., ditto
Rhodes, W. B., ditto
Richardson, C. S., Wellington
Richmond, H., Taranaki
Richmond, The Hon. J. C., Nelson
Samuels, W. R. E., Wanganui
Seymour, The Hon. A. P., Marlborough
Skey, W., Wellington
Smith, Benjamin, ditto
Smith, Charles, Wanganui
Stewart, J. T., Manawatu
Stowe, Leonard, Wellington
Symes, Dr., R.N.
Toxward, C. J., Wellington
Travers, H. H., ditto
Travers, W. T. L., F.L.S., ditto
Tuckey, H. E., ditto
Wakefield, Felix, F.L.S., Nelson
Warburton, G., Wellington
Waterhouse, The Hon. G. M., F.R.C.S., Wairarapa
Webbe, J. S., Dunedin
Willcox, H., Wellington
Woodward, J., ditto
Woon, R. W., Wanganui
Young, T. W., Wellington

AUCKLAND INSTITUTE.

Aitken, W., Auckland
Alexander, C., ditto
Allen, J. S., ditto
Allom, A. J., Shortland
Atkin, W., Tamaki
Atkin, William, Auckland
Baber, J., C.E., ditto
Ball, T., Mongonui
Barber, W. B., Devonport
Barstow, R. C., Bay of Islands
Beale, B. C., M.D., Hamilton
Beere, D. M., Shortland
Bousfield, O. L. W., Gisborne
Breton, Captain F. G., Auckland
Brookfield, F. M. P., ditto
Bruce, Rev. D., ditto
Buchanan, Jas., ditto
Buchanan, Jno., ditto
Buckland, W. T., ditto
Buller, Rev. J., Grahamstown
Campbell, H., Auckland
Chamberlain, The Hon. H., Parnell
Chapman, G. T., Auckland
Cheeseman, T. F., Remuera
Clarke, J. M., Auckland
Clarke, H. T., Tauranga
Cochrane, S., Auckland
Codrington, Rev. R. H., Norfolk Island
Cook, A. G., Upper Norwood, England
Cowie, The Right Rev. W. G., D.D., Bishop of Auckland
Cruickshank, D. B., Auckland
Daldy, W. C., ditto
Dargaville, J. M., ditto
Davy, G. H., Shortland
Diddams, J. W., Auckland
Dyson, R. W., ditto
Farmer, J., Remuera
Firth, J. C., Auckland
Fischer, C. F., Sydney
Ford, S. H., M.D., Russell
Fox, A., M.R.C.P., Shortland
George, J., Auckland
Gillies, His Honor T. B., Superintendent of the Province of Auckland
Gittos, B., Auckland
Goldsboro', C. F., M.D., ditto
Goldsmith, H., C.E., Shortland
Graham, W. K., London
Gwynneth, J., C.E., Grahamstown
Hankey, E. A., London
Harding, S., Grahamstown

Haultain, The Hon. Colonel T. M., Auckland
Hay, D., ditto
Hay, W. M., ditto
Heale, T., C.E., ditto
Heaphy, C., V.C., Major A.R.V.
Henderson, T., Jun., Auckland
Hill, W., Jun., ditto
Hunt, R. R., Ngaruawahia
Hunt, W. A., Remuera
Hutton, Capt. F. W., F.G.S., Churchill
Ireland, H., Waimate
Jackson, S., Auckland
Jones, S., ditto
Jones, W. W., M.D., Cambridge
Kidd, R., LL.D., Auckland
Kinder, Rev. J., ditto
Kirk, T., ditto
Larkworthy, F., London
Leaf, C. J., London (Life Member)
Lee, W., M.R.C.S.E., Auckland
Lowe, J., C.E., ditto
Lusk, H. H., ditto
Lyall, J. L., Epsom
MacCormick, J. C., Auckland
Macfarlane, J. S., ditto
Macfarlane, R. J., C.E., Grahamstown
Macffarlane, Thos., Auckland
Mackay, J., Jun., ditto
Mackay, R., ditto
MacKechnie, E. A., ditto
MacKellar, H. S., ditto
Mackelvie, J. T., ditto
MacLean, B., Tamaki
MacLean, The Hon. D., Napier
MacLean, E., Howick
MacLeod, J., Kawa Kawa
MacRae, F., Auckland
Mair, Major G., Tauranga
Mair, R., Wangarei
Mair, Major W. G., Opotiki
Manning, F. E., Hokianga
Matthews, E. J., Auckland
Meinertzhagen, F. H., Napier
Mitford, G. A., Parnell
Morton, H. B., Auckland
Morrin, T., ditto
Morrin, W., ditto
Monro, H. A. H., ditto
Murdoch, D. L., Epsom
Nesbitt, W. K., M.D., Auckland
Nicholson, J. R., M.D., ditto
Ogilvie, J., Auckland
O'Keefe, D., Shortland
O'Neill, C., Auckland
O'Rorke, G. M., Onehunga
Owen, G. B., Epsom
Owen, G. N., London
Palmer, W. J., Auckland
Peacock, T., ditto
Philcox, W., ditto
Philips, P. A., ditto
Phillips, C., ditto
Phillipson, T., ditto
Pollen, The Hon. D., M.D., Te Whau
Purchas, Rev. A. G., M.R.C.S.E., Onehunga
Roberton, J., Auckland
Russell, T., ditto
Sheehan, J., ditto
Sheppard, A. M., Whangape
Shera, J. M., Auckland
Sinclair, A., ditto
Smart, J., ditto
Stewart, J., C.E., ditto
Stewart, T. M., ditto
Stone, C. J., ditto
Stratford, S. J., M.R.C.S.E., Parnell
Tassell, R., M.D., Auckland
Tinne, T. F. S., ditto
Tothill, C., ditto
Upton, J. H., ditto
Upton, W. B., ditto
Vilcoq, A., Russell
Vogel, The Hon. J., Wellington
Von der Heyde, G., Auckland
Wardrop, A., ditto
Wark, J. N., Sydney, N. S. W.
Wattling, H. W., M.D., Auckland
Wayland, J. M., Onehunga
Waymouth, J., Grahamstown
Wayte, E., Auckland
Weetman, S., ditto
Weston, T. S., ditto
Whitaker, F., ditto
Will, W., ditto
Williams, H., Bay of Islands
Williams, Archdeacon W. L., Poverty Bay
Williamson, The Hon. Jas., Auckland
Williamson, John., ditto
Wilson, W. C., ditto
Wright, F. W., L.M.B. Toronto, ditto
Wrigley, J., ditto

PHILOSOPHICAL INSTITUTE OF CANTERBURY

Acland, The Hon. J. B. A.
Adams, F. T.
Anderson, John
Armstrong, J. T.
Back, Alex.
Barker, A. C.
Bealey, Samuel
Beaufort, —
Blakiston, C. R.
Blakiston, A. F. N.
Bowen, Rev. C.
Bowen, C. C., F.R.G.S.
Boys, J. C.
Bray, W. B., C.E.
Buckley, G.
Carruthers, W. D.
Coster, J. L.
Cotterill, Rev. G., M.A.
Coward, J. W. S., L.S.A.
Cox, Alfred
Craig, D.
Curtis, T. S.
Davis, Richard
Deamer, Wm., M.D.
Duncan, Andrew
Duncan, T. S.
Enys, J. D.
Fereday, R. W,
Frankish, J. D., M.D.
Fraser, Rev. C., M.A., F.G.S.
Gilchrist, J. O.
Gould, George
Goule, Captain
Graham, James E.
Gray, The Hon. E.
Gresson, Henry B., B.A., His Honor Mr. Justice
Griffiths, E. G.
Guthrie, J. S.
Haast, Julius, Ph.D., F.R.S.
Hall, George
Hall, The Hon. John
Hanmer, Philip
Harper, H. J. C., D.D., Right Rev. Bishop of Christchurch and Primate
Harper, Leonard
Harris, Rev. W. C., M.A.
Hart, George
Hassal, T. M.
Hawdon, M. D. J.
Hawkes, J. G.
Hennah, H.
Hewlings, Samuel
Holmes, George
Inglis, John
Jacobs, Very Rev. Dean, M.A.
Jameson, Andrew
Lane, W. H.
Lean, Alexander
Lee, E. J.
Lee, The Hon. G. L.
Lee, Henry
Lockyear, F.
Loughnan, —
Mainwaring, R.
Marshman, J., C.E.
Mellish, G. Lillie
Montgomery, Wm.
Mounier, —
Mountfort, B. W.
Murray-Aynsley, H. P.
Palmer, Joseph
Peacock, J. T.
Potts, T. H.
Powell, Llewellyn, M.D.
Prins, Henry Horsford
Purnell, W. C.
Reeves, W.
Rhodes, R. H.
Rolleston, W., B.A., His Honor, Superintendent of Canterbury
Ross, J. V.
Seely, E. P.
Simmonds, A. R.
Smith, J. M.
Stack, Rev. J. W.
Templar, E. M.
Thornton, G., C.E.
Townsend, R.
Triphook, T. D.
Tripp, C. G.
Turnbull, J. S., M.D.
Walker, Launcelot
Warner, G.
Webb, H. R.
Wilkin, Robert
Williams, H. W.
Williams, J. S.
Wilson, J. Cracroft, C.B.
Wilson, William
Wright, E. G.
Wright, F. E.
Wylde, J.

OTAGO INSTITUTE.

Abel, H. J.
Abram, G. P., M.A.
Adams, C. W.
Arthur, W.
Ashcroft, J.
Baker, G. S.
Barr, G. M., C.E.
Barnet, A. A.
Barton, G. B.
Bathgate, John
Bathgate, Alexander
Beal, L. O.
Bell, George
Beverley, Arthur
Blair, W. N., C.E.
Borrows, Dr.
Bower, D.
Brent, Daniel, M.A.
Brodie, G.
Buchanan, Dr.
Burns, Dr.
Butterworth, J. L.
Calcutt, Thomas
Campbell, G. H.
Cargill, E. B.
Cargill, John
Carrick, A.
Chapman, Mr Justice
Chapman, Robert
Copeland, James
Dalrymple, William
Davie, John
Deck, Dr.
Eccles, A., F.R.C.S.
Edwards, Rev. E. G., M.A.
Fraser, William
Gardner, David
Gardiner, R. S.
Gillies, Robert
Graff, John
Graham, T. S.
Granger, Rev. E. H., M.A.
Haggitt, B. C.
Haggitt, D'Arcy
Hammond, Dr.
Hardy, H. F.
Hawthorne, Stuart, M.A.
Hepburn, William
Hislop, John
Hocken, T. M., M.R.C.S.E.
Hodgkins, W. M.
Houghton, H.
Howorth, Henry
Humphreys, E. W.
Jack, A. H.
Jeffcoat, F.
Kenyon, E. P.
Langlands, W.
Law, Henderson
Logan, John
Lubicki, A. D.
Macandrew, James
Macassey, James
McGregor, John
McKerrow, James
McKerras, J. T.
Martin, R. B.
Martin, W.
Mason, William
May, J. T.
May, Mrs. J. T.
Miller, Robert, Jun.
Mitchell, John
Murison, W. D.
Muston, H.
Neill, Percy
Oliver, Richard
Oliver, Thomas
Park, J. B.
Prentice, N.
Purnell, C.
Purdie, A. C.
Quick, E. E. C.
Rattray, James
Reynolds, W. H.
Ritchie, G. M.
Roberts, F.
Ross, A. H.
Ross, John
Russell, Andrew
Russell, G. G.
Russell, Peter
Scrimgeour, Rev. Robert
Stewart, W. D.
Sievwright, Basil
Simpson, D. L.
Skey, H.
Smail, W.
Smith, A. W.
Smith, Charles
Smith, James
Stables, John
Stout, Robert
Street, C. S.

Strode, A. R. C.
Stuart, Rev. D. M.
Thomson, J. T., C.E., F.R.G.S.
Thomson, Peter
Thoneman, L.
Tolmie, W. A.
Turnbull, George
Turton, G. K.
Ulph, Thomas
Walcot, James
Walter, H. J.
Watson, J. T.
Watt, I. N.
Webb, J. S.
Weldon, T. K.
Wilding, Richard
Wilson, James
Yates, Dr. W. A.
Young, George

NELSON ASSOCIATION FOR THE PROMOTION OF SCIENCE AND INDUSTRY.

Atkinson, A. S.
Austin, Albert Duncan
Avery, John
Barnicoat, John Wallis
Batchelor, T. C.
Beaumont, R.
Blackett, John
Blundell, Francis
Broad, Charles
Brown, Alexander
Brown, Charles Hunter
Burnett, James
Carter, Thomas
Catley, James T.
Cock, J.
Collins, A. Shuckburgh
Cotterell, Dr.
Curtis, Herbert E.
Dick, S. J.
Drew, Henry
Elliott, Charles
Farrelle, Dr.
Greenwood, J. D.
Gouland, H.
Harley, Joseph
Harley, William
Hodgson, W. C.
Holloway, —
Huddleston, Frederick
Irvine, Dr. F. W.
Jackson, Benjamin
Jackson, Henry D.
Ladd, J. B.
Lee, Robert
Levestam, H. A.
Lightband, G. W.
Lowe, J. T.
Lucas, Robert
Luckie, David Mitchell
M'Donald, Donald
M'Intosh, John
Mackay, Alexander
Mackay, Joseph
Mackay, Thomas
Monro, Sir David
Moutray, J. C.
Nelson, The Bishop of
Packer, J. A.
Percy, John
Renwick, The Hon. Thomas
Richardson, Ralph
Richmond, J. C.
Rough, David
Sclanders, Alexander
Sclanders, James
Sharp, John
Shephard, Joseph
Simmonds, Rev. Frank C.
Smith, John
Squires, William Westbrooke
Stafford, E. W.
Stanton, William Moses
Tatton, J. W.
Thorpe, Rev. C.
Tingle, James
Vickerman, Francis L.
Wakefield, Felix
Wharton, H.
Williams, George
Webb, Joseph
Wells, William
Younger, Thomas

JAMES HUGHES, PRINTER, LAMBTON QUAY, WELLINGTON.

ERRATA.

PROCEEDINGS.

Page 24, line 3, for "world by" read "worldly."
,, 37, ,, 29, for "Mr. H. Crawford" read "Mr. J. C. Crawford, F.G.S.," and insert "(See *Transactions*.)"
,, 37, ,, 30, after "reservoirs" insert "to be filled by the continuous action of pumps worked by the wind."
,, 76, ,, 2, for "Auckland" read "Wellington."

TRANSACTIONS.

Page 125, line 8, after "sketch" insert "Plate XIII., fig. 1," and *dele* same from line 11.
,, 129, ,, 27, for "turned" read "tumid."
,, 143, ,, 4 and 5, *dele* "as they appear to be."
,, 160, ,, 30, for "vircus" read "virens."
,, 161, ,, 5 from bottom, after "Banks and Sol." insert "from both of which it differs."
,, 167, ,, 8 from bottom. The parenthetic clause "(includes *Gilliesianum*, etc.)" is an editorial reference, accidentally inserted, and expresses an opinion not held by the author.
,, 178, ,, 24, after "axillary" insert "erect."
,, 192, ,, 2, for "it" read "one variety at least."
,, 207, ,, 27, for "suspicious" read "surprising."
,, 214, ,, 13, for "*Palyripha nia*" read "*Polysiphonia.*"
,, 221, ,, 25, for "XXXVII." read "XXXVI."
,, 229, ,, 12, for "reduced" read "rendered."
,, 258, ,, 22, for "1·8 degrees" read "1° 8′."
,, 276, ,, 6, after "*Frost and Fire*," insert "Vol. i., p. 370."
,, 278, ,, 10, after "has been" insert "erroneously."

Directions to the Binder.—Title-page to *Proceedings* is printed at the end of Part 2. *List of Ferns* to be placed after the Appendix.

ERRATA FOR VOL. I.

CORRECTIONS to be applied to New Zealand Telegraph or Mean Time, to find Local Mean Time at the following places:—

Auckland	add	9 min. 16·7 sec.
Napier	add	17 min. 40·7 sec.
New Plymouth	add	6 min. 19·9 sec.
Wellington	add	9 min. 11·5 sec.
Nelson	add	3 min. 7·9 sec.
Picton	add	7 min. 10·0 sec.
Lyttelton	add	0 min. 57·1 sec.
Westport	subtract	3 min. 0·0 sec.
Port Chalmers	subtract	7 min. 23·3 sec.
Bluff	subtract	16 min. 32·3 sec.

NOTE.—Thi Table is to be substituted for that given in *Trans. and Proc. N. Z. Inst.*, Vol. i., p. 49, in which several copyist's errors occur.